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Final Report

Capture Rate Study

Phase III

Post-World War II Capture Rates

For Purchase Order

DASW01-99-M-1268

10 November 2000

Prepared for:

Department of the Army
Center for Army Analysis

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Chapter
1

Introduction

The Capture Rate Study is intended to develop estimations of capture rates for enemy prisoners of war (EPW). It is intended that these rates be incorporated into the Headquarters Department of the Army (HQDA) Total Army Analysis (TAA) process.

Historically, capture rates have been influenced by a variety of factors. They include posture (offensive or defensive), theater of combat, intensity of combat, outcome of the engagement, terrain, weather, force ratios, distance advanced or retreated, degree and extent of encirclements, logistics, duration of the campaign, existence of retreat routes, morale, and national characteristics. Usually, methods of calculating EPW capture rates have been based upon extracting and evaluating existing historical data.

This report addresses the third phase of the project, covering the analysis developed from 61 division-level engagements and 10 campaigns, all of them post-World War II. The analysis developed from Small Scale Contingencies (SSCs) and data on the medical condition and care of EPW will be covered in Phase IV.

This study does not address all of the issues relating to capture rates. Additional research should be done to determine the number of civilian internees (including the number who need medical care) and the number of refugees and non-interned civilians who might also be a load upon military police and medical services. More research also needs to be done on the EPW capture rates for units smaller than division (brigades, battalions, and companies).

This study is almost entirely the work of two persons, Christopher A. Lawrence and Richard C. Anderson. Project Manager Christopher A. Lawrence developed the study plan under guidance from Jeff Hall at the Center for Army Analysis (CAA). Richard C. Anderson, Jr., developed the 1956 Suez War and 1981 Falklands War Engagements. The 1973 Arab-Israeli War Engagements were drawn from the Land Warfare Database—Richard Anderson added the EPW data and other additions and modifications to the originals. The Campaign Data was also the work of Richard Anderson. Jay Karamales programmed the databases. Curt Johnson did the 1991 Gulf War Engagements. The final report was written Richard Anderson, with some analysis done by Christopher Lawrence. We also received help and support from Nicholas Krawciw, Stanley Miller (CAA) and Susan Rich.

Chapter
2

Study Plan

The Dupuy Institute study addresses the issue of the POW capture rates for division-level engagements and corps/army-level operations. No systematic effort was made to address civilian internees. The study also does not address capture rates in battalion-level echelons or lower.

The study was contractually broken into three separately funded phases. In March 2000, after the completion of Phase I & II, it was decided to add an additional fourth phase. Phase IV will have the primary task of analyzing the medical experience of EPW, it was also decided to move the analysis of EPW in Small Scale Contingency Operations (SSCO) to this phase. The major tasks in each phase are now:

Phase I:

1. Prepare the Research Plan.
2. Prepare the List of Candidate Engagements.
3. Revise the Land War Data Base (LWDB) for use as an EPW database.
4. Assemble 60 division-level Italian Campaign engagements.
5. Assemble 60 division-level Kursk Campaign engagements.
6. Prepare the Database User's Guide.

Phase II:

1. Assemble 60 division-level engagements from the Ardennes Campaign (Battle of the Bulge).
2. Assemble 60 army-level campaigns from World War II.
3. Produce EPW capture rates from analysis of the division-level database.
4. Create a Campaign Database (CaDB) for the army-level operations.
5. Produce EPW capture rates from analysis of the army-level database.
6. Prepare a Final Report addressing WWII data.

Phases I and II were completed and a final report for both was submitted in March 2000.

Phase III:

1. Assemble 60 division-level engagements from post-World War II data.

2. Assemble 13 or more army-level campaigns from post-World War II.

3. Create a Small Scale Contingency Operations (SSCO) Database.

4. Produce EPW capture rates from analysis of the post-World War II data.

5. Prepare Final Report addressing the post-WWII data and integrating the data from World War II and from post-WWII.

Phase IV:

1. Assemble 50 SSCO engagements from post-World War II.

2. Revise the Database User's Guide.

3. Prepare a Final Report on the Medical Requirements for EPW.

4. Prepare a Final Report on the Post-World War II SSCO Data.

Phase III consists entirely of post-World War II data. However, the use of post-World War II data has presented some major problems. In all cases, primary source archival data was unavailable for at least one side, and it was often unavailable for both sides. Also, because of the wide range of wars and conflicts since World War II, the time to be spent conducting in-depth research was prohibitive. As a result, we were necessarily forced to make an extensive use of secondary sources. Furthermore, the selection of battles and campaigns was driven by the availability of those secondary sources. Thus, the quality and reliability of the data was less than ideal. However, we felt that the post-WWII engagements and campaigns need to be included in the overall analysis of EPW rates. There was also some belief that changes in doctrine and technology over time may have influenced capture rates. If true, it may be shown in the analysis of the data—however flawed it may be—from the post-World War II period. If a lack of confidence remains in the analysis of the post-World War II data, then the reviewer may still rely on the more reliable two-sided data from World War II to generate EPW capture rates. By this means, we hope that all of the major concerns of data quality, reliability and currency may have been reasonably answered.

Another major problem with post-WWII data was that there has been very limited detailed statistical material assembled on these wars. As a result, not only was the quality of the data less, but the number of engagements and operations that can be developed under a fixed budget is more limited. When more analytical work is done in the post-WWII operations, then more material will be available. However, to date there is very little reliable statistical data available. As a result, assembling each engagement or operation is time consuming. This reduces the number of operations that can be done within the given project budget.

Study Timeline

During the course of Phase III the following major milestones occurred:

Phase III contract award: 29 July 1999

1. The Phase I & II Final Report was submitted on 6 March 2000. It was decided to implement a Phase IV to analyze the medical experience of EPW. It was also decided to complete the SSCO Engagements as part of Phase IV

2. The 10 post-World War II Campaigns were completed in March 2000

3. The 61 post-world War II Engagements were completed in June 2000

4. The analysis of the post-World War II Engagements and Campaigns was completed in October 2000. This completed Phase III

5. The Phase III Draft Final Report was submitted in November 2000

Phase IV Contract Award: 14 July 2000

Chapter
3

Research

Many sources were utilized for the post-World War II Engagements and Campaigns. A major resource was the Land Warfare Database (LWDB), originally created in the 1980s under contract to CAA as a report on 601 battles from 1600 to 1973. It was submitted to CAA as part of the CHASE study. At its own expense, DMSI then computerized this database in Reflex and added four additional engagements in 1986, but did not include the battle narratives. In 1989, as part of the Breakpoints project, additional 27 engagements were added to the database. In 1995, TDI, at its own expense, changed the format of the database from Reflex to Access and added all the battle narratives to the database. The result was a database of 632 engagements. The format chosen for the EPW Engagement Database was the same as that for the LWDB. Engagements developed for Phases I, II, and III of this study have yielded an additional 154 engagements to create a total of 786 engagements in the database.

A. The Arab-Israeli War Data

Of the 632 original LWDB engagements, 52 were post-World War II (Arab-Israeli Wars). All 19 of the engagements from the 1967 Arab-Israeli War and 13 engagements from the Golan Front in the 1973 October War were excluded because no reasonable methodology could be found for estimating EPW per engagement, based upon the available data. In the process of reviewing the remaining engagements, some were modified as a result of identifying more complete sources and correcting some errors in the original work. In addition, six engagements from the 1956 Suez War, including the Anglo-French Operation Musketeer, were added to the database, as were five additional engagements from the 1973 October War. As a result, the EPW Database contains 34 engagements from the Arab-Israeli Wars, six from the 1956 Suez War, one (Kerama) from the War of Attrition (1967-1973), and 27 from the 1973 Arab-Israeli War. We have reasonable confidence in the overall reliability of this data.

B. The 1981 Falklands War Data

Seven Falklands War engagements were developed for the database from secondary sources. We have good confidence in the reliability of this data.

C. The 1991 Persian Gulf War Data

Twenty Persian Gulf War engagements were developed for the database from primary sources (in the case of US units) and secondary sources. We have confidence in the reliability of the data for the Coalition Forces. The data for Iraqi forces are estimates based upon the best available data.

D. The Post-World War II Campaigns

Ten post-World War II campaigns were developed for the database from primary and secondary sources. The campaigns selected were from the three major Arab-Israeli Wars (1956, 1967, and 1973), the Falklands War (1981), and the Gulf War (1991).

Chapter
4

Data Description

The data analysis was conducted in two major steps. First, the 61 engagements were analyzed separately from the campaigns. Furthermore, the engagements were analyzed separately according to the war they occurred in before the results were combined into a final data set. Second, the campaign data was analyzed separately from the engagement data. The two data sets were then compared to each other.

A. Definitions for Purpose of Analysis

The analysis was based upon definitions developed specifically for this analysis. The following definitions were used; additional clarification, amendments, and modifications may be found in the EPW User's Guide.

Force Mix: Force mix was defined as the mix of armor and infantry in the force and was derived from the data. That is, a primarily infantry force was defined as one with less than 2 main battle tanks per 1,000 men, while an armor supported force was defined as having from 2 to 8 main battle tanks per 1,000 men and an armor heavy force was defined as having more than 8 main battle tanks per 1,000 men.

These definitions were derived so that an infantry division, even with limited armor support, would still be considered "primarily infantry," while an infantry division with one or two battalions of armor attached would be considered "armor supported." An armor division would be classified as "armor heavy." By setting a numerical value, this definition could be consistently applied to forces of very different sizes and compositions. When applied to the engagements, this proved to be a good functional definition.

For purposes of the database "Main Battle Tanks" were defined as armored fighting vehicles, including generally the principal AFV of armored divisions, armed with large caliber guns, and with the primary mission of engaging and defeating the enemy's armor; all self-propelled antitank guns; and all armored assault guns.

Force Ratios: Force ratios were measured as the personnel strength of the attacker divided by the personnel strength of the defender. These strengths are the sum, at the start of an engagement, of all personnel in the force subject to enemy fire, including generally combat and combat support troops but also service support troops if subject to enemy fire.

The LWDB also includes data on equipment, including light and main battle tanks and the number of field guns. Considerable material was gathered in the creation of these files. The Dupuy Institute has, for most of the engagements, a detailed count of the weapons that includes all large caliber weapons. Although it may have been possible to measure the force ratios based upon a scoring system of the weapons, this was not done for three reasons.

First, to assemble, count, and score the weapons would have taken a considerable additional effort, perhaps as much as that spent upon any single phase of the enabling contracts. As such, counting and scoring could not be done within the budget that was available.

Second, a scoring system was required that was "valid." To date, there is no method of validating a scoring system outside of the model that it is used in. Only one such scoring system has been validated within a model (Trevor N. Dupuy's Operational Lethality Indices). Other scoring systems exist based upon "face validation." Any analytical use of a scoring system would have to include a test of its reliability (prediction capability). As such, any such effort would either require accepting a scoring system based upon faith or conducting an independent test of the validity of the scoring system. Accepting a system based upon faith does not necessarily improve the accuracy or confidence of the resulting analysis. Testing a scoring system is time consuming and would have required additional effort.

Finally, in many cases, a scoring system would not have significantly changed the strength ratio in the engagements. In many cases the opposing forces were similar in armament and organization. It is unknown if the force ratios for those engagements where there was an asymmetrical organization of the opposing forces would have changed significantly in any consistent direction. It is possible that the changes in the force ratios from using a scoring system would have averaged out, resulting in no significant change in the analytical results.

Since the force ratio was one of only four factors used to test the data with, it was decided that including a weapons scoring system did not make sense in this study.

Outcome: As a result of examining the data, it became clear that the capture rates were affected by the outcome of the engagement. The analysts then defined a series of engagement outcomes, and classified all of the engagements according to those definitions. The seven engagement outcomes were defined as:

Limited Action - An engagement characterized by limited activity by either side. In this case the category of attacker and defender may be arbitrary, but is usually determined by the side on the strategic or operational offensive during the period of the engagement.

Limited Attack - An engagement in which the attacker's offensive activity is characterized by patrols, raids, or by attacks with limited objectives. Limited attacks include feints and secondary attacks that are part of larger battles.

Failed Attack - An engagement in which the attacker attempts to mount a significant attack with the intention of dislodging the enemy, but does not make a significant advance and does not achieve its objective.

Attack Advances - An engagement in which the attacker advances, but does not achieve a clear-cut penetration of the defender's position. Depending on the degree with which the attack achieved its objective, the attacker may or may not be the winner.

Defender Penetrated - An engagement in which the attacker achieves a penetration of the defender's position. In this case the attacker is almost invariably the winner.

Defender Enveloped - An engagement in which the attacker achieves a penetration or breakthrough of the defender's position and successfully envelops or surrounds a major part of the defending force.

Other – Is any outcome that could not be described by the other six categories.

Note that these definitions were applied based upon a careful analysis of the course of the engagement and its result. The definition was not simply based upon "winners" and "losers" or on the assigned mission accomplishment scores of the participants. Only a single engagement in Phase II was designated as "Other," and none in Phase III were.

B. The Arab-Israeli Wars Engagements

There are a total of 6 engagements from the 1956 Suez War, 1 from the War of Attrition and 27 from the 1973 October War in the EPW data base. All were used for the purposes of the statistics and analysis below. All of the engagements, except for the Syrian Assault on Mount Hermon, were brigade or division-level actions. The engagements include Israeli, Egyptian, and Syrian actions.

16 were Israeli offensive actions versus Egyptian forces
5 were Israeli offensive actions versus Syrian forces
1 was an Israeli offensive action versus Jordanian/PLO forces
1 was an Anglo-French offensive action versus Egyptian forces
9 were Egyptian offensive actions versus the Israelis
2 were Syrian offensive actions versus the Israelis

The battles occurred in similar climatic and terrain conditions.

6 were in Desert-Temperate Climate
18 were in predominately Rolling Dunes Terrain
10 were in predominately Rugged-Bare Terrain
1 was in predominately Urban Terrain
4 were River Crossings
1 was an Amphibious assault

The average strengths were:

Total Average Strength:	18,009
Average Attacker Strength:	23,036
Average Defender Strength:	12,983

The highest strength was 139,120 (Egyptian Army attacking at Suez Canal Stalemate). The lowest strength was 55 (elements of the Israeli Golani Brigade defending at Syrian Assault on Mount Hermon). There were 11 engagements in which the defender had fewer than 5,000 men. There were eight engagements in which the attacker had fewer than 5,000 men and seven in which both sides had fewer than 5,000 men.

The force ratios (measured as attacker strength divided by defender strength) for the sides varied widely. The average force ratio was 2.54 to 1, while the weighted force ratio (total attackers in all engagements divided by total defenders in all engagements) was 1.77 to 1. The highest force ratio was 12.18 to 1 (Suez Canal Assault Center). The lowest was 0.50 to 1 (Mount Hermon II).

The battles were mostly of one day in length. Twenty-one battles were one day, six battles were two days, five were three days, one was four days, and one was five days in duration. The longest battle—five days in length—was Ismailia. The average battle was 1.68 days in length.

The force mix varied widely, but in most of the engagements there was a significant amount of armor present. There were two engagements in which both sides were primarily infantry forces. In seven of the engagements, one side was primarily infantry. In 26 of the engagements, one side was armor heavy. In 19 of the engagements, both sides were armor heavy. In three of the engagements, both sides were armor supported.

The average attacker tank (MBT) strength per engagement was 237. In four of these engagements the attacker had only light armor, and in three of these the defender had no armor. The average defender tank strength per engagement was 142. The highest tank strength was 885. In 19 of the engagements the attacker had 150 or more tanks. The defender had more than 150 tanks in 13 of the engagements.

The battles selected were mostly drawn from the existing engagements in the Land Warfare Database. As such, they usually record events that occurred during periods of intense combat. This means that only one of the outcomes was "limited attack." Ten outcomes were "failed attack," seven were "attack advances," 13 were "defender penetrated," and three were "defender surrounded." There were no "limited action" or "other" engagements.

Casualties ranged from a high of 2,005 for the attacker at Third Army Offensive and 6,000 for the defender at Shallufa II to a low of 10 for the defender at Mount Hermon II. The average casualties were 401 for the attacker and 944 for the defender.

As a percentage of the force engaged, the highest casualties were 100 percent per day (the defender in Gaza) and the lowest casualties were 0.12 percent per day (the defender in Suez Stalemate). The average attacker percent loss per day was 2.08 percent versus 17.81 percent for the defender. The weighted average, based upon total casualties divided by total strength, was 1.74 percent for the attacker and 7.27 percent for the defender.

The highest reported number of Enemy Prisoners of War captured was 5,500 by the attacker at Shallufa II and the lowest was 0 in 31 instances. However, in all of these instances, there were no reports of captures in the records. By the nature of the data, it is impossible to say whether or not there were captures in these cases. However, an analysis of these battles and wars indicates that the number captured would have been quite small. In 24 of the cases in which no captures were recorded, the force was on the defensive.

The average number of EPWs captured by the attacker was 321 (191 per day), while the defender captured an anemic 10 (6 per day). The highest percent captured was 92 percent of strength (the defender at Shallufa II), while the lowest was zero. The average percent CIA lost by the attacker was 0.04 percent of strength or 0.03 percent per day. The average CIA lost by the defender was 2.47 percent of strength or 1.47 percent per day. CIA as a percent of the total casualties ranges from 0 to 100. The attacker lost an average of only 2.49 percent of their casualties as CIA, while the defender lost an average of 34.36 percent!

C. The Falklands War Engagements

There are a total of seven engagements in the EPW database from the Falkland Islands War. All are battalion-level engagements or lower. All of the engagements were British attacks on Argentine forces. All occurred in cold climate conditions (although not in heavy snow) and in rugged, bare terrain. None of the engagements were river-crossing operations and none occurred in an urban environment.

Average Strength:	511
Average Attacker Strength:	474
Average Defender Strength:	549

The highest strength was 1,324 for the defender at Darwin-Goose Green. The lowest strength was 17 for the defender at Top Malo House.

The force ratios (measured as attacker strength divided by defender strength) for the sides were similar. The average force ratio was 1.02 to 1, while the weighted force ratio (total attackers in all engagements versus total defenders in all engagements) was 0.86 to 1. The highest force ratio was 1.25 to 1 (Top Malo House). The lowest ratio was 0.41 to 1 (Darwin-Goose Green).

All of the battles were one day in length and in all cases, the result was "defender penetrated."

The force mixes did not vary. In five of the engagements neither side had any armor forces. In two engagements the attacker was supported by light tanks and may be considered to be armor supported forces. In comparison, the Arab-Israeli engagements were primarily between armor-supported or armor heavy forces.

The defender casualties ranged from a high of 223 (Darwin-Goose Green) to a low of 17 (Top Malo House). The attacker casualties ranged from a high of 70 (Mount Longdon) to a low of 0 (Top Malo House). Average casualties were 29 for the attacker and 110 for the defender. Average casualties per day were the same.

The average attacker loss per day was 5.28 percent. The average defender loss per day was 31.86 percent. The weighted daily average (based upon total casualties divided by total strengths) was 6.12 percent for the attacker and 14.55 percent for the defender.

The highest number of Enemy Prisoners of War reported captured were 173 (by the attacker at Darwin-Goose Green) and the lowest was 0 by the defender in all seven cases.

The average number of EPWs captured by the attacker was 83. The highest percent captured was 100 percent of strength (Top Malo House) while the lowest was 6.80 percent (Mount Tumbledown). The average CIA lost by the defender was 15.18 percent of strength per day. From 29.82 to 100 percent of defenders loss was as CIA. If a weighted average of total casualties versus total CIA is used, then 75.88 percent of the defender casualties were CIA.

D. The Persian Gulf War Engagements

There are a total of 20 engagements from the Persian Gulf War (DESERT STORM) in the EPW database. The engagements cover a mix of Iraqi and Coalition Forces offensive actions. The engagements occurred mostly in rolling-bare, flat-bare, or rolling desert terrain. There are no river crossings and no battles in an urban environment. The weather was temperate.

Average Strength:	9,722
Average Attacker Strength:	10,996
Average Defender Strength:	8,448

The highest strength was 22,000 (the attacker at PL New Jersey). The lowest strength was 600 (the defender at Big Night). There are eight engagements in which one side had fewer than 5,000 men.

The force ratios (measured as attacker strength divided by defender strength) for the sides varied widely. The average force ratio was 2.17 to 1, while the weighted force ratio (total attackers divided by total defenders in all engagements) was 1.30 to 1. The highest force ratio was 5.70 to 1 (73 Easting). The lowest force ratio was 0.20 to 1 (Al Wafrah).

The battles are of varied duration and nominally cover a total of 35 days of combat. However, this is one of the few instances in which it has been possible to calculate—with some degree of accuracy—the number of hours of combat. The 20 engagements cover approximately 470 hours, or just over 19.5 days of combat, averaging about one day in length.

The force mix is not well defined. Armor strength for the Iraqi forces is subject to numerous and widely varying interpretations, while the exact strength of Allied formations is not known in many cases. However, in the eight cases in which the armor strength for one side is known the majorities are armor heavy engagements. In only one of the eight engagements does the armor fall to less than one tank per 1,000 troops. It appears that, in general, the forces of the Coalition Allies were effectively armor heavy or armor supported while the Iraqi forces were, at best, armor supported.

In the eight engagements in which armor strength is known, the average attacker tank (MBT) strength per engagement was 182 (in two of the eight the attacker armor strength was unknown). In the single case where the defender tank strength was known it was 126. The highest tank strength was 357.

None of the outcomes were "limited actions" or "limited attacks." Four of the outcomes were "failed attack," one was "attack advances," 13 were "defender penetrated," and two were "defender enveloped." All of the failed attacks were by the Iraqis

Casualties varied from a high of 2,000 for the attacker at Al Burqan Airfield and 4,300 for the defender at 1st MarDiv Breach, to a low of zero in three cases for the attacker. The average casualties were 135 for the attacker and 887 for the defender. The highest casualty rate (calculated as the percent of the force engaged per day) was 69 percent for the defender at Big Fight, and the lowest was zero percent in three cases for the attacker. The average attacker loss rate was 0.93 percent per day and it was 28.08 percent per day for the defender. The weighted average rate (based upon the total casualties divided by the total strength) was 1.23 percent for the attacker and 10.50 percent for the defender.

The highest number of EPW reported captured was 4,000 (by the attacker in two cases, at PL New Jersey and at 1st MarDiv Breach) and the lowest was 0 in 21 instances. It should be noted that there were no recorded cases of Coalition troops being captured by Iraqi forces in these engagements. The average number of EPW captured by the attacker was 823, while the average number of EPW captured by the defender was 120 (but in only three cases). The highest loss to captures was 50 percent of strength (by the defender at Big Night), while the lowest was zero percent.

The average rate of CIA lost by the attacker was 0.05 percent of strength. For the defender it was 0.49 percent of strength. Calculated as a percent of the total casualties, CIA ranged from 100 percent to 0 percent of the loss, with the attacker losing zero casualties as CIA in three cases, while the defender lost an average of 93.38 percent of their casualties as CIA! The weighted averages were 88.99 percent and 92.86 percent respectively.

These CIA figures were obviously heavily influenced by human factors. The effect of human factors on the EPW capture rates was dealt with extensively in the Phases I and II report.

E. The Post-World War II Operations

The second part of the EPW database consists of ten post-World War II operations, filed in a separate computerized database. This database is similar to, but not identical to, the database used for the engagements. The campaigns were defined as army-level operations from six to 60 days in length. Only one-half of the ten operations recorded fit this definition, the average being 10.50 days. The other five operations were quite brief, averaging only 3.40 days in length. The operations chosen were from the 1956 Arab-Israeli War (Suez War), the 1967 Arab-Israeli War (Six-Day War), the 1973 Arab-Israeli War (Yom Kippur War), the Falklands Islands War, and the Persian Gulf War.

Average Strength: 103,458

Average Attacker Strength: 118,940

Average Defender Strength: 87,977

The lowest strength for the attacker was 8,500 (British Army in "Falklands Islands") and the highest strength was 400,000 (the Coalition Forces "DESERT STORM"). The lowest strength for the defender was 3,000 (the Egyptians in "MUSKETEER") and the highest strength was 222,000 (the Iraqi Army in "DESERT STORM"). There were two operations where the attacker had less than 40,000 troops and four where the attacker had less than 60,000 troops. There were three operations where the defender had less than 40,000 troops and five where the defender had less than 60,000 troops. None of these army-level operations were excluded from the analysis.

These operations covered a mix of Israeli, Egyptian, Syrian, British, and US operations, including:

6 Israeli offensive operations
1 Egyptian offensive operation
1 Syrian offensive operation
1 British offensive operation
1 US offensive operation

The force ratios (measured as attacker strength divided by defender strength) for the sides varied widely. The average force ratio was 1.85 to 1, while the weighted force ratio (total of all attackers divided by the total of all defenders) was 1.35 to 1. The highest force ratio was 7.33 to 1 (MUSKETEER). The lowest ratio was 0.56 to 1 (Falklands Island War).

There were a variety of force mixes. If the army-level definition of infantry, armor supported, and armor heavy (less than 1 tank per thousand is infantry, from 1 to 4 tanks per thousand is armor supported, and more than 4 tanks per thousand is armor heavy) is used, then there was one operation

where both sides were primarily infantry (Falklands Island War), two where one side was armor supported and seven where both sides were armor heavy.

The average attacker tank (MBT) strength per operation was 908. The average defender tank strength per operation was 758. The highest tank strength was 3,360 (Coalition Forces in "DESERT STORM"). In four of the operations the attacker had 500 or more tanks. In six of the operations, the defender also had more than 500 tanks.

None of the outcomes were "other," "limited action," or "limited attack," one was "failed attack," two were "attack advances," three were "defender penetrated," and four were "defender enveloped."

Attacker casualties ranged from a high of 5,474 (the Egyptian Army in "BADHR-Egyptian Attack) to a low of 155 (Anglo-French Forces in "MUSKETEER"). Defender casualties ranged from a high of 64,000 (the Iraqi Army in "DESERT STORM") to a low of 1,735 (the Egyptian Army in "MUSKETEER").

Average casualties were 2,922 for the attacker and 13,528 for the defender. As a percent of the force engaged, the highest casualties were 19 percent per day (the Egyptian Army defending in "MUSKETEER") and the lowest casualties were 0.05 percent per day (the Allied Coalition attacking in "DESERT STORM"). The average attacker percent per day loss was 0.45 percent and for the defender it was 3.97 percent. The weighted daily averages (based upon total casualties divided by total strengths divided by average number of days) were 0.23 percent for the attacker and 1.46 percent for the defender.

The highest reported number of EPW captured was 63,000 (by the attacker in DESERT STORM) and the lowest was 0 in six cases. The average number of EPW captured by the attacker was 9,196 or 876 per day. The average number of EPW captured by the defender was 85 or 8 per day. The highest percent captured was 28 percent of strength (the Iraqi Army in "DESERT STORM"), while the lowest percent was zero.

The average percent of CIA lost by the attacker was 0.01 percent of strength. The average CIA lost by the defender was 0.91 percent of strength. As a percent of the total casualties, CIA accounted for 100% to 0% of the losses. An average 2.93 percent of the attacker casualties were CIA, an average of 67.99 percent of the defender casualties were CIA!

One of the main reasons for developing the Campaign Data Base was to compare the difference in capture rates between army-level operations and division-level engagements. This was due to concerns that the two were not directly comparable. This concern was magnified by previous studies that generated averages from databases that included operations as diverse as "Barbarossa" (the invasion of Russia), and "Just Cause" (Grenada), and treated them with equal weight and significance. One cannot apply the data from one level of aggregation to another level without understanding that the statistics for different levels of combat may differ.

The following chart shows an engagement-level and army-level view of the Suez Canal Front in the 1973 Arab-Israeli Yom Kippur War.

	Division-level Engagements	Army-level Operations	Ratio Division-level to Army-level
Israeli Offensive Actions	12	1	
Egyptian Offensive Actions	8	1	
Average Attacker Strength	31,398	182,500	1 to 5.81
Average Defender Strength	17,415	146,250	1 to 8.40
Average Force Ratio	2.84 to 1	1.49 to 1	
Weighted Force Ratio	1.80 to 1	1.25 to 1	
Average Length (Days)	1.7	8.5	1 to 5
Average Attacker MBT Strength	328	1,497	1 to 4.56
Average Defender MBT Strength	183	1,389	1 to 7.59
Attacker Casualties	551	4,724	1 to 8.57
Average per Day	324	556	1 to 1.72
Percent per Day	1	0	**1 to 3.43**
Average Defender Casualties	1,001	11,582	1 to 11.57
Average per Day	589	1,363	1 to 2.31
Percent per Day	3	1	**1 to 3.63**
Average Attacker EPW	385	4,015	1 to 10.43
Average per Day	226	472	1 o 2.09
Average Defender EPW	16	165	1 to 10.00
Average per Day	9	19	1 to 2.11
Average Attacker Percent CIA	0.05	0.09	
Percent Loss to CIA	2.9	3.49	
Average Defender Percent CIA	2.21	2.75	
Percent Loss to CIA	38.46	34.67	

This comparison of the engagements to the campaigns well illustrates the effect of operational tempo. With forces six times larger and operations that are five times longer, the campaigns show average daily casualties and average daily capture rates that are, at most, only twice those found in the engagements. This naturally translates into daily casualty rates and daily capture rates that are about one-third of those in the engagements. **The operational tempo for these army-level operations is about one-third of that in the division-level engagements for these cases.**

F. Comparison to World War II Data

One of the main goals of this report is to determine if the EPW Capture Rate (and warfare in general) has changed significantly since World War II. Is reliable World War II data still valid for use in analysis, or should we rely on the far less reliable and more limited post-World War II data?

During Phases I and II, three sets of engagement data were collected. One set covered the Italian Campaign from September 1943 to June 1944, one covered the Ardennes Campaign from December 1944 and January 1945, and the third set covered the Battle of Kursk from July 1943.

The following chart summarizes the result of that data.

Phase I and II Engagement Data	Italian	Ardennes	Kursk
Number of Engagements	75	71	49
Average Attacker Strength	16,945	15,024	28,521
Average Defender Strength	8,506	9,311	20,782
Average Force Ratio	2.34	2.79	1.67
Weighted Force Ratio	1.99	1.61	1.37
Average Battle Lengths (days)	2.41	1.61	1.39
Average Attacker Tank Strength	77	84	86
Average Defender Tank Strength	40	37	59
Average Attacker Casualties	429	256	442
Average Defender Casualties	421	548	596
Average Attacker Casualties per Day	178	160	319
Average Defender Casualties per Day	174	341	430
Average Attacker Percent Loss per Day	1.35	1.87	1.38
Average Defender Percent Loss per Day	1.93	7.16	4.38
Weighted Attacker Percent Loss per Day	1.05	1.71	1.55
Weighted Defender Percent Loss per Day	2.05	5.89	2.87
Average Number of Attacker EPW	140	283	263
Average Number of Attacker EPW per Day	60	176	170
Average Number of Defender EPW	52	28	22
Average Number of Defender EPW per Day	22	18	16
Average Percent of Attacker CIA	0.41	0.24	0.08
Average Percent of Attacker CIA per Day	0.17	0.15	0.06
Average Percent of Defender CIA	1.56	7.21	2.79
Average Percent of Defender CIA per Day	0.65	4.49	2.76
Average Percent Attacker Losses are CIA	13.58	14.37	6.10
Average Percent Defender Losses are CIA	33.07	33.69	26.50
Total Percent Attacker Losses are CIA	12.24	11	4.98
Total Percent Defender Losses are CIA	33.20	51.59	39.66

As was discussed in the Phase I and II Report, the similarities between the Italian and Ardennes data were more significant than the differences. Some of these differences may be driven by a change in the relative combat effectiveness of US to German forces over time. In both data bases, the US was usually the attacker.

The Kursk data was definitely influenced by a clear combat effectiveness differential between the German (who were usually attacking) and the Soviet forces (who were usually defending). These differences are discussed in full in the Phase I and II Report.

The following chart summarizes the post-World War II data.

Post-World War II Data	Arab-Israeli	Falklands	Gulf War
Number of Engagements	34	7	20
Average Attacker Strength	23,036	474	10,996
Average Defender Strength	12,983	549	8,448
Average Force Ratio	2.54	1.02	2.17
Weighted Force Ratio	1.77	0.86	1.3
Average Battle Lengths (days)	1.68	1	@ 1
Average Attacker Tank Strength	237	0	182 (8 cases)
Average Defender Tank Strength	142	0	126 (1 case)
Average Attacker Casualties	401	29	135
Average Defender Casualties	944	110	887
Average Attacker Casualties per Day	29	135	
Average Defender Casualties per Day	110	887	
Average Attacker Percent Loss per Day	2.08	5.28	0.93
Average Defender Percent Loss per Day	17.81	31.86	28.08
Weighted Attacker Percent Loss per Day	1.74	6.12	1.23
Weighted Defender Percent Loss per Day	7.27	14.55	10.5
Average Number of Attacker EPW	321	83	823
Average Number of Attacker EPW per Day	191	83	823
Average Number of Defender EPW	10	0	120
Average Number of Defender EPW per Day	6	0	120
Average Percent of Attacker CIA	0.04	0	0.05
Average Percent of Attacker CIA per Day	0.03	0	0.05
Average Percent of Defender CIA	2.47	15.18	0.49
Average Percent of Defender CIA per Day	1.47	15.18	0.49
Average Percent Attacker Losses are CIA	2.49	0	0
Average Percent Defender Losses are CIA	34.36	75.45	88.99
Total Percent Attacker Losses are CIA	2.49	0	0
Total Percent Defender Losses are CIA	34.36	75.88	92.86

A simple comparison of these six data sets (the three World War II and three post-World War II) yields the following observations:

- **The strength and force ratios of the Arab-Israeli and Gulf War data are similar to the World War II Data.** The Falklands War data is clearly different, effectively a small number of very one-sided battalion-level actions. The Falklands War data would better be compared to the battalion-level data from World War II (for which we currently only have 7 cases).

- **The Arab-Israeli and Gulf War engagements are dominated by armor, much more so than any of the three sets of World War II engagements.**

- **The attacker loss rates in the Arab-Israeli War and Gulf War engagements are similar to those in the World War II data.** However, the defender loss rates are much higher. This may be explained by human factors and should be examined further.

- **The attacker definitely captured many more EPW in the post-World War II data than in the WWII data.** Again, this may be explained by human factors and should be examined further. Conversely, the number of attackers captured is very low, which is expected from the mix of the engagements. Thirty-one of the 54 engagements in the Arab-Israeli and Gulf War were cases where the defender was penetrated or enveloped.

• **The percent of casualties that were captured in the Arab-Israeli engagements is comparable to the World War II data.** The high percent of casualties captured in the Falklands and Gulf War clearly indicate the effect of human factors.

A quick comparison tends to show that the strength, force ratios, and length of operations were not radically different from those in World War II. What is different is the greater density of armor and the much higher defender casualty rates. In the case of the Arab-Israeli battles, the defender casualty rates were higher, but not significantly greater than those in World War II were. In the case of the Falklands War and the Gulf War, the casualty rates of the defender were quite high and were clearly driven by the high number of defenders captured. This points to human factors affecting the data in one of two ways: either one side began with poor morale or the conditions of the battle seriously reduced the morale of one side (due to overwhelming opposition firepower, airpower, or tempo of operations) resulting in a large number surrendering.

• **Overall, it does not appear that modern technology, warfare, or doctrine significantly changed the outcome except where it may have caused a significant decline in the morale of the opposition.** Regardless, it does not appear that combat results and EPW rates were significantly different from World War II figures, at least through 1973.

This last point is somewhat reinforced by comparing the 1973 Arab-Israeli War division-level and army-level comparison with that done from the World War II Italian Campaign data in the report for Phases I and II. For reference, the World War II table is repeated:

	Division-level Engagements	Army-level Operations	Ratio, Division-level to Army-level
Allied Offensive Actions	59	26	
German Offensive Actions	17	3	
Average Defender Strength	8,506	70,928	1 to 8.3
Average Force Ratio	2.34 to 1	3.25 to 1	
Weighted Force Ratio	1.99 to 1	2.61 to 1	
Average Battle Length (Days)	2.41	25.14	1 to 10.4
Average Defender Tank Strength	40	157	1 to 3.9
Average Defender Casualties	421	4,799	1 to 11.4
Average Defender Casualties per day	174	191	1 to 1.1
Average Defender Percent Loss per day	1.93	0.3	1 to .2
Weighted Defender Percent Loss per day	2.05	0.25	1 to .1
Average Number of Defender EPW	52	411	1 to 7.9
Average Number of Defender EPW per day	22	16	1 to .7
Average Percent of Defender CIA	1.56	2.11	1 to 1.4
Average Percent of Defender CIA per day	0.65	0.11	1 to .2
Average Percent Defender Losses are CIA	33.07	25.88	1 to .8
Total Percent Defender Losses are CIA	33.2	32.49	1 to 1.0

The conclusion from this and other comparisons in the Phase I and II Report was that army-level operations in Italy were about ten times the size and duration of the division-level engagements in the same period. This ratio is found in the average attacker strength, the average defender strength, the average battle length, the average attacker casualties, the average defender casualties, the average number of attacker EPW, and the average number of defender EPW. The average attacker tank strength is larger, but only by a factor of seven. The average defender tank strength is larger by a factor of four.

The force ratio for the operations and the engagements are similar, as are—surprisingly enough—the average attacker and defender daily casualties. Furthermore, the average number of EPW captured per day is also similar between the operations and engagements, as is the average percent of attacker CIA, the average percent of defender CIA, and the four various calculations of percent losses that are CIA. What remain different are the percent of casualties lost per day and the percent captured per day, which is consistently about one-fifth to one-tenth of the rate in the engagements for both attacker and defender. There are three major conclusions that may be drawn from analyzing the army-level data:

- **The casualty rates and capture rates for army-level operations are about one-fifth to one-tenth of those for division-level engagements.**

- **It is clearly a huge methodological error to lump the rates from large operations such as BARBAROSSA together with small operations such as JUST CAUSE.**

- **The engagement data from the Italian Campaign is a representative sample of battles from the campaign.**

Looking at the similar comparison using the 1973 Arab-Israeli War data, a similar pattern is seen. Here the operations are about five times larger and longer. Unlike the Italian data, the force ratios for the division-level engagements are higher than for the army-level operations. The tank strengths follow the same relationship as the unit strength. Overall, casualties are around eight to 12 times higher for the army-level operations, and the total casualties per day are twice as high for the army-level operations. The same relationship occurs for the number captured.

This supports several conclusions:

- **It remains a mistake to lump together capture rates from very different size operations.**

- **Another is that the engagements in the 1973 Arab-Israeli War are a fairly representative selection from the war as a whole.** However, as the engagements selected represented virtually every major action in the fighting in 1973 between the Egyptians and the Israelis, this is not surprising.

- **The casualty rates for the division-level engagements are about three times that of the campaign-level.** This is different from the Italian data where the division-level was about ten times that of the campaign-level. In the case of the division-level engagements, the casualties for the attacker were about the same as those for the World War II engagements in terms of both absolute numbers and in the percent of combat strength. For the defenders, the rates were much higher, but not unlike other WWII data found.

The real difference in the data is that the Italian Campaign army-level operations averaged about 25 days in length, while the Arab-Israeli War operations averaged around eight days in length. As such, this is not a direct comparison between similar data, since the 1973 Arab-Israeli War represented two weeks of very intense operations, while the Italian Campaign covered 10 months of operations that varied from very high to very low intensity. Still, both sets of data display a daily loss percentage for the attacker that is similar (0.19 for World War II versus 0.30 for the Arab-Israeli War), but very different percentages for the defender (0.25 for World War II, versus 0.93 for the Arab-Israeli War).

What is clear is that the intensity of the division-level engagements is not significantly different between the Arab-Israeli Wars and World War II. If the average length of the operations in the Italian data versus the Arab-Israeli War data and the daily loss rate in the various army-level operations are considered, then there seems to be absolutely no indication that operations in the Arab-Israeli War were more intense, bloodier, or were executed at a higher pace or tempo. This appears to be true for both division-level engagements and army-level operations. The only major difference—the defender casualty rate—is not radically different from World War II data and most likely can be entirely explained as a function of human factors. **It would appear that the intensity and tempo of operations up through 1973 is about the same as that in World War II.** This is despite the technological improvements that had occurred over the intervening 30 years. As such, except for the issue of force mix (which clearly plays a role here) and human factors, data for combat operations up through 1973 appear to be usable interchangeably with data from World War II. **There are no signs of an "evolution in military affairs," let alone a "revolution in military affairs."** One can also postulate that this will hold true for any two warring countries that do not use technology that is not significantly more sophisticated than that used in the 1973 Arab-Israeli War. This certainly applies to every conflict up through 2000, except possibly for the Gulf War.

A comparison to the Falklands War data is irrelevant, due to the small number of examples (seven engagements) and the small size of those actions (battalion-level or smaller). The casualties are not out of line with other battalion-level data we have examined, except for the high number of surrenders by the defender. These very lop-sided infantry engagements were against a defender that was clearly demoralized and are useful primarily for demonstrating the severe loss of combat effectiveness that can result from a collapse in morale.

It is the Gulf War data that remains the most interesting and tantalizing. For, while there may not have been major and significant changes in warfare from 1943 to 1973, there may have been such a change within the last 20 or 30 years that could potentially obviate all or some of the lessons that can be learned from the World War II and Arab-Israeli War data.

The Arab-Israeli War and Gulf War engagements demonstrate both differences and similarities. The force ratio, the length of the engagement, the defender casualties, and the number of tanks are similar (but, as the Gulf War engagements tended to be smaller, the number of armor heavy engagements tended to be higher). The attacker casualties (which are much lower, especially if the four examples of Iraqi attacks are deleted), attacker percent loss per day (which are lower), and the defender percent loss per day (which are higher for the Gulf War engagements) are different. This may partly be a function of the unit size or force mixture, but it is suspected that human factors are again the primary cause. EPW show a very one sided result in the Gulf War: all prisoners were Iraqi and they made up more than 90 percent of Iraq's casualties.

While nothing concrete can be drawn from this comparison, it does appear that there was a significant difference in morale between the forces that fought in the Gulf War. Whether there were other differences caused by changes in technology, and whether those differences in technology caused the morale problem, are more difficult questions to answer. This will be discussed more fully in Section V, *Measuring Human Factors in Combat*, which follows.

G. The Enemy Prisoner of War Data

For this study the engagements were assembled in a database identical to the format used in the Land Warfare Database. Each record in the database has 121 fields, only a small number of which are used for the EPW analysis. The complete EPW database, which includes narrative descriptions of the battles, was provided to CAA as part of this contract.

The army-level operations are assembled into a database compatible with the format used for the Campaign Database. As such, each record in the database has 130 fields. Again, only a small number of those fields are used for the above analysis. The completed parts of the Campaign Data Base used for this study, which includes narrative descriptions of the operations, was provided to CAA as part of this contract.

Unfortunately there is no guarantee that in twenty years the disks will be readable, copyable, or will even maintain their electronic signature, so it was decided to enclose the most pertinent data as Appendices I-V of this report.

Chapter
5

Measuring Human Factors in Combat

Armed forces do not all fight with the same degree of effectiveness. Their performance and capabilities in battle can and do vary widely. The differences go far beyond the numbers, mix, and capabilities of the weapons brought onto the field of battle. There are entire ranges of "force multipliers" that are related to the performance of human beings (and groups of human beings) on the battlefield. These force multipliers, what The Dupuy Institute refers to as "Combat Effectiveness," include such factors as leadership, generalship, training, experience, morale, motivation, cohesion, intelligence (including interpretation), momentum, initiative, doctrine, the effects of surprise, logistical systems, organizational habits, and even cultural differences. Human factors are hard to measure. As such, the analytical community often ignores them.

For this study, it is impossible to ignore such issues as morale, motivation, and cohesion. These components of "Combat Effectiveness" have an effect on both combat capability and EPW capture rates. One would expect more personnel to surrender in a force with lower morale, motivation, and cohesion (less combat effectiveness), than in one with higher morale, motivation, and cohesion (more combat effectiveness). For this study, we address combat effectiveness as it is related to the EPW capture rates, believing that a proper estimation of EPW capture rates cannot be developed without taking into account combat effectiveness. Therefore, this study will digress briefly to discuss the measurable effects that we have been able to obtain from the data collected. These effects are measured by relative combat effectiveness, which includes morale, motivation, and unit cohesion.

As developed by Trevor N. Dupuy, effectiveness differences in opposing combat forces may be measured in three ways:

Mission accomplishment, which is a measurement of who won or lost. This can be determined either by judgment or by whether the attacker advanced. The Dupuy Institute prefers to use judgment, as it is common for the attacker to make limited advances in attacks that are otherwise disastrous. In most cases, however, there is no difference between the results made from judgment and those made based upon a rigid measurement of advance rates.

Mission accomplishment can also be defined by a mission success score. This was done in the EPW database by assigning a score of 0 to 10, based again on judgment, to both sides. Since all measurements of mission accomplishment are imprecise and subject to judgment, it was decided not to use it for further analysis.

Casualty effectiveness, which is a measurement of the relative ability of one side to inflict casualties upon the other. This may be the best measure of combat effectiveness, although it has some weaknesses, including the lack of precision common to many casualty reports. Another weakness is that not all nationalities classify or report their casualties in the same way. This is a particular problem when wounded are reported, and can make a comparison of total casualties a little difficult. Total casualties, meaning the total of killed-in-action (KIA), wounded-in-action (WIA) and missing-in-action (MIA), are what are used for casualty comparisons in this study, even though there may be some concern over how the WIA were reported.

There are some alternatives to a simple comparison of total casualties. For instance, it is possible to compare total killed on both sides. This could generate odd comparisons if one side suffered a large number of MIA resulting in a low, under-reported, number of KIA. Another alternative would be to compare total losses, that is, the total of KIA and MIA. This measurement might be useful, but it too has some problems. For example, in a situation where a defender is overrun, a certain percent of those that would normally be WIA become CIA. As such, the attacker casualties would include KIA and MIA, while the defender casualties would include KIA, MIA, and those WIA that could not escape and which are recorded by the defender as MIA. This would tend to inflate the defender loss relative to the attacker. For these reasons, it was decided to use total casualties as a measurement.

Spatial Effectiveness, which is the measurement (usually in kilometers per day) of the ability to advance. This is probably the weakest metric and as such is not used in this study. However, a combat effectiveness difference between armies clearly exists, regarding their ability to maneuver and exploit opportunities in combat. Still, the problems with this metric tend to outweigh any advantages. Opposed advance rates are often surprisingly difficult to measure. Furthermore, it is often driven by the ability of an army to take advantage of available gaps in the opposing front and it is heavily influenced by external factors like terrain and degree of motorization. Sometimes advance rates are limited by the desire of an attacker to advance or by where objectives are. In some cases, they are limited by the depth of the terrain (for example, battles in the Pacific Atolls in WWII).

Finally, all of these measurements must consider the conditions of combat. These include not only any inherent advantages of being on the defense, but also terrain, weather, and many other factors. Furthermore, these measurements also need to consider the mix of weapons and the capabilities of the weapons of each side. Obviously, a heavy armor force well supported by artillery will have a greater effective combat power than an unsupported mass of infantry. Also, the effects of air power need to be considered. To address these three factors (conditions, weapons, air power) would require an analytical structure, most likely a combat model, which is well beyond the scope and budget of this project. Therefore, these factors were not considered except in the simplest terms.

A. The Arab-Israeli Comparisons

The 34 Arab-Israeli engagements actually consist of different data sets from two wars (1956 and 1973) and from the Battle of Kerama (1968). The engagements include five Israeli attacks against Egyptians forces from the 1956 war, 15 Israeli attacks against Egyptian, Syrian, Iraqi, and Jordanian/PLO forces in 1968 (one case) and 1973, and 13 Egyptian/Syria/Iraqi attacks against Israeli forces in 1973. For the sake of this analysis, we will not attempt to separate the various Arab armies into their national components, as the majority of cases are Egyptian. The number of Syrian/Iraqi/Jordanian cases (four attacking and four defending) is simply not statistically significant enough to justify measuring them separately. Furthermore, there is no collection of qualitative assessment that strongly indicates that there was a significant difference in performance between the Egyptian Army and the Syrian Army.

First, the following chart examines the results of the engagements.

Arab-Israeli Wars Engagement Results	Israeli Attacking Egyptian	Israeli Attacking Arab	Arab Attacking Israeli
Year	**1956**	**1968-1973**	**1973**
Number of Cases	6	15	13
Percent Success	83%*	67%	46%
Average Attacker Casualties	179	316	602
Average Defender Casualties	1,803	1,251	195
Average Force Ratio	1.92	1.14	4.44
Weighted Force Ratio	1.87	1	2.53
Average Casualty Ratio	0.25	0.64	3.89
Weighted Casualty Ratio	0.1	0.25	3.09
Percent of Defender's CIA	27.96	3.71	0.07
Percent of Defender Casualties that are CIA	55.56	41.09	5.96

* The Abu Ageila engagement outcome is "Attacker Advances," but is still counted as a defender victory because none of the initial objectives were reached, and the road that was so vital to Israeli success remained blocked. The successful Israeli advance was a result of a political decision on the part of the Egyptian government, which decided to abandon the Sinai.

This data paints a very clear picture. Israeli attacks caused about four casualties for every one they suffered (3.96 to 1). Arab attacks lost three casualties for every one they inflicted (3.09 to 1). Arab casualties are worse when defending ("the stronger form of combat") due to the large number of penetrations and envelopments that occur when the Israelis attack.

If only the non-penetrating and non-enveloping attacks are compared the result is still an interesting comparison, although the number of cases are so small that it is dangerous to draw conclusions from them.

Arab-Israeli Wars Engagement Results excluding penetrations and envelopments	Israeli Attacking Egyptian	Israeli Attacking Arab	Arab Attacking Israeli
Year	**1956**	**1973 (1 exception)**	**1973**
Number of Cases	2	7	9
Percent Success	50%	43%	22%
Average Attacker Casualties	379	383	784
Average Defender Casualties	685	682	231
Average Force Ratio	3.04	0.89	4.81
Weighted Force Ratio	3.45	0.88	3.39
Average Casualty Ratio	0.59	1.03	2.47
Weighted Casualty Ratio	0.55	0.56	2.25
Percent of Defender's CIA	4.46	0.76	0.04
Percent of Defender Casualties that are CIA	32.36	15.54	1.03

Force Ratio	Casualty Ratio	Outcome
Israeli Attacking Egyptian (1967)		
4.57	0.94	Advances
2.17	0.03	Penetrated
1.81	0.04	Penetrated
1.50	0.23	Advances
0.75	0.22	Penetrated
0.70	0.02	Enveloped
Israeli Attacking Arab Armies (1956/1973)		
2.5	0.65	Penetrated
1.66	0.37	Penetrated
1.5	0.41	Penetrated
1.47	0.20	Penetrated
1.35	0.30	Failed
1.22	1.15	Advances
1.08	0.42	Penetrated
0.97	0.01	Enveloped
0.92	0.60	Advances
0.91	0.07	Penetrated
0.79	1.83	Failed
0.74	0.20	Advances
0.71	0.15	Failed
0.71	0.27	Penetrated
0.5	3.00	Failed
Arab Armies Attacking Israeli (1973)		
12.18	2.72	Penetrated
9.09	1.14	Enveloped
8.12	2.62	Penetrated
6.06	0.74	Penetrated
4.57	0.36	Advances
4.11	0.69	Advances
3.50	15.42	Failed
2.25	0.98	Failed
2.22	3.27	Failed
1.93	4.15	Limited
1.75	8.60	Failed
1.05	1.80	Failed
0.87	8.02	Failed

A casualty exchange ratio in favor of the Israelis can still be seen. The ratio is by a factor of two (actually 1.78 to 1) when attacking and three (3.38 to 1) when defending. This is closer to what would be expected if there were some advantage to being on the defense. Again, though, the number of cases remains very small.

For comparative purposes, the force ratio versus the casualty ratio in the Arab-Israeli engagements is shown in the table at left.

Examining these force ratios is revealing. The Israelis attacked a total of ten times while outnumbered. Those attacks succeeded in seven of the ten times. In contrast, the Arab attacks succeeded only when they outnumbered their opponent by more than four to one.

It should be remembered that there was effectively technological parity in these wars. The Israelis used mostly modern US, UK, and French equipment, while the Egyptians, Syrians, and Iraqis used mostly modern Soviet equipment. Both sides made some use of tanks that dated back to WWII (US M4s and Soviet T34s). The Israelis may well have had superior aircraft, but the effects of air-to-air combat are not measured here, nor did it have a dominant effect on the ground action. There were few battles in which there was strong Israeli air support.

In the Phase I & II Report, a comparison that showed a significant difference in combat effectiveness was that of the Germans versus the Soviets in the division-level engagements from the Battle of Kursk. This comparison is shown below:

German-Soviet Kursk Engagement Results	German Attacking Soviet	Soviet Attacking German
Year	**1943**	**1943**
Number of Cases	31	18
Percent Success	61%	17%
Percent Success less Cat I (limited action) attacks	79%	18%
Percent Success less Cat I & II (limited action) attacks	94%	30%
Average Attacker Casualties	255	761
Average Defender Casualties	869	126
Average Force Ratio	1.78	1.72
Weighted Force Ratio	1.34	1.43
Average Casualty Ratio	0.69	5.40
Weighted Casualty Ratio	0.30	6.04
Percent of Defender CIA	1.68	0.05
Percent of Defender's Casualties that are CIA	42.40	7.05

These differences are even more significant than those found in the Arab-Israeli comparison. When the Germans attacked they caused about three casualties (3.41 to 1) for every one they lost (compared to about four to one in the Israeli attacks). When the Germans defended they caused six casualties (6.04 to 1) for every one they suffered (compared to about three to one for Israeli defenses).

Overall, in these 49 engagements, counting both when they were attacking and defending, the Germans inflicted 41,405 casualties while losing 10,173, for a four to one exchange ratio (4.07 to 1). For the 28 engagements from the 1973 war (and Kerama), the Israelis inflicted 26,585 casualties while losing 7,269 in the 1968-1973 engagements, also for roughly a four to one exchange ratio (3.66 to 1). From this data one is tempted to conclude that the difference between the casualty effectiveness (and possibly combat effectiveness) of the Germans versus the Soviets was similar to that of the Israeli versus the Arabs. However, it also appears that the Soviet Army was simply more stubborn, in both the attack and the defense, than were the Arabs.

Again, airpower is not considered in this analysis, although the Germans tended to have air superiority over the Kursk battlefield, but not air supremacy. Over one-half the battles were fought without any significant intervention by air on either side.

For attacks with no penetrations or envelopments, and with all the limited attacks and limited actions removed, the following results are tabulated:

German-Soviet Kursk Engagement Results
excluding penetrations and envelopments

	German Attacking Soviet	Soviet Attacking German
Year	**1943**	**1943**
Number of Cases	10	10
Percent Success	90%	30%
Average Attacker Casualties	365	1,191
Average Defender Casualties	955	176
Average Force Ratio	1.68	2.1
Weighted Force Ratio	1.58	1.61
Average Casualty Ratio	0.51	6.96
Weighted Casualty Ratio	0.38	6.78
Percent of Defender CIA	1.11	0.07
Percent of Defender's Casualties that are CIA	26.66	7.99

As can be seen when comparing non-penetrating or non-enveloping attacks, and when all the minor "limited actions" and "limited attacks" are eliminated, the casualty exchange ratio in favor of the Germans is still around two-and-one-half to one (2.61 to 1) when attacking (compared to 1.78 to 1 for the Israeli attacks). In cases when the Soviets attacked, the casualty exchange ratio is even worse, around seven to one (6.78 to 1), but this is clearly due to the large number (70 percent) of failed attacks. In contrast, in the cases in which the Arabs attacked, the exchange ratio is only 3.38 to one. It would appear that the difference is not necessarily relative competency, but is in fact a result of the evident Soviet Army obsession with attack missions (which we term mission obsessive attacks), aggravated by a more limited ability of the troops involved to choose not to attack. The higher exchange ratios on the part of the Soviet Army points to them being more "stubborn" than the Arabs in the attack and defense, in addition to being less capable than their respective opponents.

Still, the question of relative competency is brought to the fore by the fact that 90 percent of the German attacks succeeded, while only 43 percent of the Israeli attacks did, yet the Soviets had a worse exchange ratio. Furthermore, 78 percent of the Arab attacks in 1973 were also failures, yet they did not

suffer the same loss rate as the Soviets did. Of course, these are comparisons of very small data sets, with only seven to ten examples of each case (attacking/defending and German/Soviet versus Israeli/Arab). However, the data consistently points to a single conclusion.

The force ratio versus the casualty ratio in the Kursk engagements is:

Force Ratio	Casualty Ratio	Outcome
Germans Attcking Soviets		
11.67	0.03	Enveloped
3.79	0.18	Penetrated
3.66	0.65	Advances
2.11	0.87	Advances
2.10	0.21	Advances
2.07	0.26	Penetrated
1.91	0.18	Advances
1.42	0.22	Advances
1.35	0.29	Penetrated
1.32	1.41	Advances
1.25	0.18	Enveloped
1.23	0.42	Advances
1.18	0.18	Penetrated
1.01	0.48	Advances
0.87	0.10	Enveloped
0.63	0.44	Advances
0.63	0.30	Fails
Germans Attcking Soviets, limited actions and limited attacks		
3.77	3.06	Limited Attack *
1.90	1.27	Limited Attack *
1.78	0.39	Limited Attack *
1.00	1.89	Limited Attack
1.00	0.77	Limited Action
0.94	1.00	Limited Action
1.09	1.21	Limited Attack **
0.84	1.07	Limited Action
0.84	0.48	Limited Action
0.82	0.41	Limited Action
0.75	1.10	Limited Attack
0.75	0.69	Limited Attack
0.72	1.28	Limited Action
0.63	0.33	Limited Action
Soviets Attacking Germans		
5.17	0.85	Fails
2.89	5.44	Fails
2.87	8.39	Fails
2.54	6.19	Advances
1.65	15.55	Advances
1.34	1.07	Advances
1.28	2.41	Fails
1.2	7.21	Fails
1.05	20.29	Fails
1.02	2.22	Fails
Soviets Attacking Germans, limited actions and limited attacks		
2.68	4.54	Limited Attack **
1.53	3.24	Limited Attack
1.24	0.96	Limited Attack **
1.23	4	Limited Attack **
1.19	4.78	Limited Attack **
0.83	3.94	Limited Attack **
0.81	2.05	Limited Action
0.51	4.02	Limited Attack **

* The attacker is judged to have won the limited attack.

** The defender is judged to have won the limited attack.

All other results for limited attacks are considered as draws.

There is a clear pattern to the Arab-Israeli data. The Israelis, with one exception, only fail when attacking at odds of less than 0.8 to one. Of the five attacks that were made at odds ranging from 0.5 to 0.8, three failed. The single Israeli attack that failed above that threshold was at 1.35 to one and 90 percent of the attacks made at over 0.8 to one succeeded.

For the German Army, there is a similar pattern. The single failed attack out of 17 (not counting limited attacks and limited actions) was at a ratio of 0.6 to one. There were only two attacks at less than 0.8 to one, and one of them was the failure (but both were at 0.6 to one).

None of the Arab attacks succeeded unless they were at a force ratio of four to one or greater. In contrast, for the Soviet Army, there were three successful attacks between 1.3 to one and 2.5 to one, but there were failed attacks at both higher and lower odds.

Examining only low-odds attacks reveal the following results:

Kursk Campaign Data	Total Force	Total Loss
All Soviet Attacks (18)	1.43 to 1	6.04 to 1
Soviet low-odds attacks (12) (between 0.51 and 1.34 to 1)	1.02 to 1	3.92 to 1
All German Attacks (31)	1.34 to 1	0.30 to 1
German low-odds attacks (21) (between 0.63 and 1.42 to 1)	0.99 to 1	0.27 to 1
Arab-Israeli Data (1968 & 1973)		
All Arab Attacks (13)	2.53 to 1	3.09 to 1
Arab low-odds attacks (2) (between 0.87 and 1.05 to 1)	0.95 to 1	3.87 to 1
All Israeli Attacks (15)	1.00 to 1	0.25 to 1
Israeli low-odds attacks (13) (between 0.50 and 1.50 to 1)	0.93 to 1	0.24 to 1

This data points to the following conclusions:

- **The casualty effectiveness – relative to their opponents – was similar between the German and the Soviet Army, and between the Israeli and the Arab Armies.**

- **The Soviet Army appeared more willing to take casualties in both the offense and defense.**

- **As a result the Soviet Army often had a worse casualty exchange ratio than Arab Armies.**

- **Regardless of the competency of the army they faced, the German and Israeli attackers were taking a chance when they attacked while outnumbered (especially at ratios below 0.8 to 1).** They may have had almost no chance to win when they attacked at odds of less than 0.5 to 1.

- **The Arab Armies did not appear willing to accept the casualties required to make attacks at ratios below four to one succeed.**

- **The Soviet Army appeared willing to accept the casualties required to make attacks at below four to one succeed, but the casualty exchange ratio (the cost of such an effort) was very high.**

- **Overall, there is no direct correlation between force ratios and casualty exchange ratios in the data.** However, both the Kursk data and the Arab-Israeli data show a tendency for lower odds attacks (below four to one) to have unfavorable casualty rates for forces with lower combat effectiveness (Soviet or Arab). The same pattern is not clearly shown for the force with superior combat effectiveness.

This, of course, is not to claim that the combat effectiveness of the Soviet Army and the Arab Armies were similar. For this to be the case, then the combat effectiveness of the German Army in 1943 and the Israeli Army in 1973 would also have had to be similar. However, this comparison cannot be clearly measured.

The German Army in 1943 had four years of combat experience and was a national conscript army. It was created by a society oriented and structured to fight wars and had participated in a major war 21 years earlier. It was one of the most economically and industrially developed nations in the world. Similarly, the Israeli Army of 1973 had participated in wars in 1967, 1956, and 1948 (respectively six, 17, and 25 years earlier) and the core of the force came from units that had fought in World War II (1939-1945). It was also a national conscript army. Israel was also a society oriented and structured to fight wars. It was a "first world" type nation, with considerable immigration from the developed areas of Europe and the United States, including extensive migration from Eastern Europe. It also included a large percent of Israelis born and raised in the Middle East.

While one cannot draw a clear parallel, there is no reason to assume that the Israeli Army of 1973 was superior to the German Army in 1943. As was shown in the Phase I & II Report the German Army in World War II was at least comparable—if not superior—to its U.S., UK, and Soviet opponents. There does not appear to be strong evidence that the Israeli Army was significantly inferior in competence (at least not by an order of magnitude) to the German Army in 1943. One could make the argument that it was somewhat inferior to the German Army of 1943, but such an argument is currently not supported by sound data.

B. The Falklands Engagements

For the seven Falklands engagements, the data shows the following (in all cases the British were the attackers and all of the outcomes were "defender penetrated"):

Falkland Engagement Results	Britain Attacking Argentina
Year	**1982**
Number of Cases	7
Percent Success	100%
Average Attacker Casualties	29
Average Defender Casualties	110
Average Force Ratio	1.01
Weighted Force Ratio	0.86
Average Casualty Ratio	0.25
Weighted Casualty Ratio	0.27
Percent of Defender CIA	12.91
Percent of Defender's Casualties that are CIA	64.42

There is no requirement for further analysis of this data. Six of the seven attacks were at roughly one to one (either 1.1 to one or 1.2 to one) while one attack (the largest battle) was at 0.4 to one. The casualty exchange ratio and other data seem to indicate that the difference in relative performance of the Argentine versus the British Army was worse than that of the Soviet versus the German Army in 1943 and the Egyptian versus the Israeli Army in 1973. However, the Argentine performance was better than that of the Egyptian Army in the Suez in 1956, where most of the engagements were brigade-size. No conclusions could be drawn from this small data set.

C. The Gulf War Engagements

Coalition forces attacked in 16 of the 20 Gulf War cases (14 US, one French, and one British). The Iraqi Army attacked in four cases. The overall statistics are:

The Gulf War Engagement Results	Coalition Attacking Iraqi	Iraqi Attacking Coalition
Year	**1991**	**1991**
Number of Cases	16	4
Percent Success	100%	0%
Average Attacker Casualties	15	667
Average Defender Casualties	1,102	25
Average Force Ratio	2.46	1.01
Weighted Force Ratio	1.74	0.51
Average Casualty Ratio	0.03	31.26*
Weighted Casualty Ratio	0.01	26.96
Percent of Defender CIA	14.80	0
Percent of Defender's Casualties that are CIA	93.38	0

* In one engagement, the defender suffered no losses.

The performance of the Iraqi Army, even with the rather conservative estimates of Iraqi strengths and casualties that were used in this analysis, was abysmal. It appears to be abysmal in both the attack and the defense, although the data is too sketchy to determine if it is as equally abysmal in the attack as in the defense. In the case of the four Iraqi attacks, the data is heavily influenced by the engagement at Al Burqun Airfield, where they suffered an estimated 2,000 casualties. If this case is excluded, then a total of 669 Iraqis were lost versus 82 coalition casualties or an exchange rate of 8.16 to one. In these three attacks, neither side had air support.

There are only two other Iraqi battles in the database. One is the Iraqi attack at Tel el Hara in the 1973 Arab-Israeli War, in which they attacked while slightly outnumbered (0.9 to one), failed, and lost eight casualties for every one inflicted on the Israelis. Second is the Iraqi defense at Kfar Shams-Tel Antar in the same war. In this case the Israelis attacked when slightly outnumbered (0.9 to one), won, and suffered an exchange ratio of 0.6 Israelis for every Iraqi.

Overall, there is some basis to believe, looking at the two examples from the 1973 Arab-Israeli War and the three examples from the Gulf War prior to the start of the Coalition ground offensive, that the Iraqi Army, while not good, was a least capable of putting up some fight. The exchange ratio from the 16 US attacks and the single Iraqi counter-attack that occurred between 24 and 27 February 1981 clearly show a radically lower degree of Iraqi combat effectiveness. It is difficult to believe that any army could have had a worse performance.

D. Percent of Casualties That are Captured

The percent of casualties that are captured may hold some answers to the question of relative combat effectiveness. The engagements analyzed by the percent of the defender casualties that are CIA are as follows:

Percent of Casualties that are Captured	Year	# Cases	% Defender Cas that are CIA	% Defender that are CIA
Iraqi attacking Coalition	1991	4	0	0
Arab attacking Israeli	1973	13	5.96	0.07
Soviet attacking German	1943	18	7.05	0.50
Israeli attacking Arab	1973	15	41.09	3.71
German attacking Soviet	1943	31	42.40	1.68
Israeli attacking Egyptian	1956	6	55.56	27.96
British attacking Argentine	1982	7	64.42	12.91
Coalition attacking Iraqi	1991	16	93.38	14.80

The cases in which the result was "failed attack" or "attack advances" are:

Percent of Casualties that are Captured	Year	# Cases	% Defender Cas that are CIA	% Defender that are CIA
Iraqi attacking Coalition	1991	4	0	0
Arab attacking Israeli	1973	9	1.03	0.04
Soviet attacking German	1943	10	7.99	0.07
Israeli attacking Arab	1973	7	15.54	0.76
German attacking Soviet	1943	10	26.66	1.11
Israeli attacking Egyptian	1956	2	32.36	4.45
Coalition attacking Iraqi	1991	1	100.00	8.00

Again, the data appear to point in a single direction. The percent of defender casualties that are CIA varies, and this appears to be a factor of unit size and is therefore insignificant here. What is significant is that there does appear to be a clear correlation between combat performance and the percent of defender casualties that are CIA. Significantly, in armies from motivated modern states the number of CIA is less than ten percent of the total casualties. The same trend is seen when looking at the US, UK, and German data from the 1943-1944 Italian Campaign and the 1944 Ardennes Campaign. There appears to be a single set of data for all of these "motivated modern states."

The next level of combat effectiveness appears to be that of the Soviet Army in 1943 and the Arab armies in 1973, which both lose about 40 percent of their casualties as captured in action. These figures are lower when one takes out the penetrations and envelopments, but still the Arab and Soviet figures are not that far from each other. What this points to is that the Soviet Army in 1943 and the Arab armies in 1973 may have had similar degrees of motivation, morale, and cohesion. This tends to point to both of these armies being similar in combat effectiveness.

One can also see that the Egyptian Army of 1956 and the Argentine Army of 1982 appear to have had worse morale than that shown in the 1943/1973 data. Finally, the Gulf War data shows the Iraqi Army as performing particularly poorly. Only the Italian Army in 1940-43 appears comparable in the database. Still, it is difficult to compare them directly since the Italian data is not from battles, but in fact is from campaigns. Still, a similar percent of their casualties are CIA (90.3 percent for the Italians and 93.4 for the Iraqis) and similar poor casualty exchange ratios (16 to one for the Italians and 60 to one for the Iraqis) can be seen.

This difference in overall casualty effectiveness could be explained by differing Italian and Iraqi morale (which does not appear to be that significant), force ratio (the Iraqis were almost always outnumbered), the nature of terrain or conditions of combat, the level of combat (army-level compared to division-level data), overwhelming coalition airpower, or changes in combat over time (the revolution in military affairs).

Another noticeable point is that the armies that perform poorly tend to have a high percentage of their own troops captured even when they are attacking. For instance:

Percent of Casualties that are Captured	Year	# Cases	% Attacker Cas that are CIA	% Attacker that are CIA
[illegible]	1973	13	3.43	0.05
[illegible]	1943	18	7.39	0.21
[illegible]	1991	4	90	7

Again, the evidence points to Arab and Soviet morale being remarkably similar, while that of the Iraqis is much worse. In fact the percent of Iraqi casualties that were CIA is similar whether they were attacking or defending. Since all of the Iraqi attacks occurred in situations where the Coalition did not have immediate air support available (they mostly were at night), then this indicates that air support was not the primary cause for the high rate of Iraqi surrenders. Nor does it point to a revolution in military affairs. It would appear that the primary Iraqi problem was abysmally poor morale. Whether this was caused by the month-long air campaign or by other factors cannot be determined without a more direct research effort. As a final comparison, in the Italian army-level operations examined in Phase II (five cases), only 4.11 percent of the Italian losses were captured in action when they were attacking. This is quite different from the pattern seen in the Iraqi cases.

E. Conclusions

The purpose of this discussion of human factors is threefold. First, is to understand how human factors affect the capture rate. Second, is to help determine if warfare has changed significantly over the 55 years since the end of World War II, enough so as to make the use of data from that war questionable. Third, is to determine if the post-World War II data can be mixed and matched with the World War II data so as to create a larger database from which to draw.

The first purpose is met to the extent that all of the trends previously seen have been confirmed. These trends show that there are at least four levels of relative combat performance.

- **There is the standard set by motivated modern armies from developed nations** (in the data base these are the US, UK, and Germany in World War II, and the US, UK, France, and Israel post-World War II).

- **There is a lower level of performance that is exemplified by the Soviet Union in 1943 and the Arab armies in 1973.** This level appears to generate a much lower degree of success. It requires higher force ratios to successfully attack. It almost always must outnumber the attacker to be successful in the defense. It suffers about three times as many casualties as its opponent, and about 40 percent of its casualties are lost to surrender when defending, and 3 to 10 percent of its casualties are lost to surrender even when attacking.

- **There is another tier of "worse" performance.** It clearly includes the unmotivated Italians (1940-1943), the demoralized Argentines (1982), and the poorly run Egyptian Army of 1956. The defining characteristic of this level is that the performance is much worse than that of units in the second tier.

- **Finally there appears to be a fourth level, which consists of the abysmally ineffective Iraqis of 1991.**

For the purpose of generating capture rates, it appears that the Kursk data in 1943 and the Arab-Israeli data in 1973 can be lumped together. The rest of the post-World War II data cannot be used without developing further examples.

The second purpose, which is to help determine whether warfare has changed significantly over that last 55 years, appears to be answered in the negative, or at least there is not much evidence of a change in the statistics. There appears to be no reason to believe that there is any difference affecting capture rates (or casualty rates for that matter) through 1982. It cannot be absolutely determined whether the Gulf War demonstrates the results of a revolution or evolution in military affairs, the effects of long-term air bombardment, or just how poor and demoralized the Iraqi Army was. Due to what appears to be poor Iraqi performance in the attack, there does not appear to be much evidence displayed of a revolution. Any evolutionary effects in the changes in warfare are certainly submerged in the data. The degree to which airpower played a part in demoralizing the Iraqi army cannot be determined without further study. The fact that the army performed as poorly when they were attacking in late January as they did when they were defending three weeks later points strongly towards it being a particularly poor and demoralized army even before the air campaign was near completion. Because of the unique nature of the opponent, one is hesitant to lump this data in with all the other data.

The third purpose, which is to determine if post-World War II data can be mixed and matched with World War II data appears to have been answered in the positive. Since the World War II data is more reliable, this is good.

Chapter
6

The Analysis

The following were again determined to have had an impact on capture rates.

- Posture (attacking or defending)
- Outcome (the result of the engagement)
- Force Mix (armor ratios)
- Combat Effectiveness

A. Impact of Outcome and Posture on Capture Rates

In the following four charts, Chart 1 covers the 28 Arab-Israeli War engagements from 1968 and 1973, divided by the six outcome categories and by posture (whether attacker or defender). Chart 2 covers the same data for the 6 engagements of the 1956 Arab-Israeli War, Chart 3 covers the 7 Falklands War engagements, and Chart 4 covers the 20 Persian Gulf War engagements. Chart 5 combines the data from Charts 1, 2, 3, and 4.

The Arab-Israeli War engagements show a pattern consistent with that found in the World War II Engagements in Phases I and II. With one exception, as the degree of success increases for the attacker, their casualties, measured as a percent of strength per day, declines, while the defender's casualties increase. The exception in the case of the attacker in the outcome "defender enveloped" appears to be due to the small number of cases. The attacker casualty rate in the three cases actually ranges from a low of 0.43 to a high of 10.0, skewing the result.

The average CIA, measured as a percent of strength per day, is effectively the same for attacker and defender in the case of "limited action." In the case of "failed attack," the defender still loses CIA at six times the attacker's rate. As the degree of success increases, the defender's CIA loss rate increases dramatically, by a factor of over six from "attack advances" to "defender penetrated," and doubling again, increasing by a factor of twelve from "defender penetrated" to "defender enveloped."

The Falklands War engagements are interesting in that, although they only consist of cases of "defender penetrated," they do appear to reflect the higher intensity level of these battalion-level actions. Both the attacker and defenders loss rates are about three times that of the Arab-Israeli engagements, while the CIA rate for the defender (there were no attacker CIA) was about five times that in the Arab-Israeli engagements. It is difficult to assess the percent of the total actual casualties that were CIA, since in many of the Falklands engagements the majority of the Argentine casualties that are known and that are recorded in the database were CIA.

Assessing the percent of casualties that were CIA is also a problem in the Gulf War engagements. Known Iraqi casualties consisted almost entirely of CIA. Except in the cases of the "defender enveloped," the defender's CIA rate was from two to eight times greater than comparable rates in the Arab-Israeli War engagements, but about one-half of the rate in the Falklands War engagements.

In general, it appears that the same general pattern found in the Phase I & II World War II engagements also applies to the post-World War II engagements.

Chart 1: Arab-Israeli War Engagements (28 Cases)

	I	II	III	IV	V	VI
Number of engagements	0	1	10	5	10	2
Attacker % casualties per day	-	0.26	2.77	1.99	0.92	5.21
Defender % casualties per day	-	0.12	3.87	3.61	39.23	65.00
Attacker % CIA per day	-	0.01	0.10	0.00	0.00	0.00
Defender % CIA per day	-	0.01	0.65	0.46	0.89	41.09
Attacker, % of casualties that are CIA	-	4.29	2.73	0.00	0.00	0.00
Defender, % of casualties that are CIA	-	10.82	13.76	10.19	18.44	68.56

Chart 2: Arab-Israeli 1956 War Engagements (6 Cases)

	I	II	III	IV	V	VI
Number of engagements	0	0	0	2	3	1
Attacker % casualties per day	-	-	-	1.32	1.22	0.78
Defender % casualties per day	-	-	-	8.30	42.92	33.33
Attacker % CIA per day	-	-	-	0.00	0.00	0.02
Defender % CIA per day	-	-	-	0.89	34.48	28.94
Attacker, % of casualties that are CIA	-	-	-	0.00	0.00	2.38
Defender, % of casualties that are CIA	-	-	-	17.88	57.99	86.83

Chart 3: Falklands War Engagements (8 Cases)

	I	II	III	IV	V	VI
Number of engagements	0	0	0	0	7	0
Attacker % casualties per day	-	-	-	-	5.28	-
Defender % casualties per day	-	-	-	-	31.86	-
Attacker % CIA per day	-	-	-	-	0.00	-
Defender % CIA per day	-	-	-	-	21.74	-
Attacker, % of casualties that are CIA	-	-	-	-	0.00	-
Defender, % of casualties that are CIA	-	-	-	-	75.62	-

Chart 4: Persian Gulf War Engagements (20 Cases)

	I	II	III	IV	V	VI
Number of engagements	0	0	4	1	13	2
Attacker % casualties per day	-	-	4.27	0.17	0.06	0.04
Defender % casualties per day	-	-	0.14	4.00	11.43	8.69
Attacker % CIA per day	-	-	4.23	0.00	0.00	0.00
Defender % CIA per day	-	-	0.00	4.00	9.37	3.05
Attacker, % of casualties that are CIA	-	-	97.57	0.00	0.00	0.00
Defender, % of casualties that are CIA	-	-	0.00	100.00	81.98	100.00

Chart 5: Summation (Compiled Data)						
	I	II	III	IV	V	VI
Number of engagements	0	1	14	8	33	5
Attacker % casualties per day	-	0.26	3.20	1.60	1.36	2.54
Defender % casualties per day	-	0.12	2.80	4.83	15.10	49.48
Attacker % CIA per day	-	0.01	1.28	-	-	-
Defender % CIA per day	-	0.01	0.46	1.01	9.85	39.86
Attacker, % of casualties that are CIA	-	4.29	29.83	-	-	-
Defender, % of casualties that are CIA	-	10.82	9.83	23.34	60.61	87.10

B. Human Factors

Because human factor differences dominate all post-World War II battles, any analysis needs to separate the data by nationality. As such, what we have is not a set of norms, regardless of nationality, as we were able to obtain from the World War II data. Instead we have a set of norms based upon performance differences between combatants.

First, presented below is the compiled data from the 75 Italian Campaign cases, the 71 Ardennes cases, and the 49 Kursk cases from the Phase I & II Final Report.

Summation (Compiled Data)						
	I	II	III	IV	V	VI
Number of engagements	9	20	54	71	33	8
Attacker % casualties per day	0.24	0.80	2.98	1.20	0.83	1.20
Defender % casualties per day	0.20	0.80	2.62	2.96	6.40	36.00
Attacker % CIA per day	0.05	0.04	0.43	0.11	0.02	0.06
Defender % CIA per day	0.04	0.24	0.34	0.92	2.98	30.43
Attacker, % of casualties that are CIA	17.54	9.56	16.21	10.22	2.67	3.06
Defender, % of casualties that are CIA	27.45	24.10	12.98	35.85	47.20	79.70

(Table 7 from page 77, EPW Phase I and II Final Report)

By removing twenty-one of the Soviet data points and a single Ardennes data point, the final recommended rates were produced. This is identical to the summation table above except for the data for outcomes I and II.

	I	II	III	IV	V	VI
Attacker % CIA per day	0.01	0.01	0.43	0.11	0.02	0.06
Defender % CIA per day	0.02	0.17	0.34	0.92	2.98	30.43
Attacker, % of casualties that are CIA	3.59	3.59	16.21	10.22	2.67	3.06
Defender, % of casualties that are CIA	4.52	14.35	12.98	35.85	47.20	79.70

(Table 10 from page 90, EPW Phase I and II Final Report)

It was felt that a table based on 49 Soviet versus German cases as an example of "less capable armies" was going to be too small. As it appears that the 1968-1973 examples are similar in size and nature to the German/Soviet examples it is possible to create a composite table by combining the 49 Kursk cases with the 28 Arab-Israeli cases from 1973 (and Kerama). This is presented below:

Germans/Israelis Attacking

German-Soviet / Arab-Israeli	I	II	III	IV	V	VI
Attacker % casualties per day						
German	0.16	0.73	0.83	1.30	0.91	0.75
Israeli	-	-	2.88	2.98	1.82	0.43
Defender % casualties per day						
German	0.13	0.84	1.74	5.35	7.59	38.32
Israeli	-	-	2.73	4.03	7.37	50.00
Attacker % CIA per day						
German	0.00	0.00	0.01	0.01	0.00	0.01
Israeli	-	-	0.10	0.00	0.00	0.00
Defender % CIA per day						
German	0.04	0.37	0.24	1.09	2.86	36.85
Israeli	-	-	0.80	0.39	0.97	45.83
Attacker, % of casualties that are CIA						
German	3.50	1.09	0.79	1.52	0.47	0.93
Israeli	-	-	2.74	0.00	0.00	0.00
Defender, % of casualties that are CIA						
German	34.00	42.22	13.64	30.95	36.54	79.28
Israeli	-	-	12.21	10.87	15.03	91.67

Germans/Israelis Defending

German-Soviet / Arab-Israeli	I	II	III	IV	V	VI
Attacker % casualties per day						
Soviet	1.01	0.81	3.32	3.54	-	-
Arab	-	0.26	2.66	0.24	0.87	10.00
Defender % casualties per day						
Soviet	0.40	0.28	0.95	1.03	-	-
Arab	-	0.12	1.03	2.08	4.34	80.00
Attacker % CIA per day						
Soviet	0.34	0.10	0.12	0.31	-	-
Arab	-	0.01	0.09	0.00	0.00	0.00
Defender % CIA per day						
Soviet	0.02	0.01	0.04	0.06	-	-
Arab	-	0.01	0.01	0.10	0.70	36.36
Attacker, % of casualties that are CIA						
Soviet	33.33	23.38	4.60	12.45	-	-
Arab	-	4.29	3.13	0.00	0.00	0.00
Defender, % of casualties that are CIA						
Soviet	4.55	2.37	5.74	8.00	-	-
Arab	-	10.82	0.35	4.75	14.59	45.45

There are three outliers in this data. All are smaller brigade- or battalion-sized engagements. They include an Israeli low-odds attack that failed (Mt. Hermon II, 500 attacking 1,000), an Israeli attack that penetrated (Mt. Hermon III, 2,500 attacking 1,000), and a successful encirclement by the Syrians

(Mt. Hermon, 500 attacking 55). The statistics change somewhat if these three Mt. Hermon engagements are left out of the data. The same data for the outcomes III and V, less these outliers, follows:

Israelis Attacking		
Number of Engagements: Old / New		
Attacker % casualties per day		
Old	2.88	1.82
New	1.84	1.10
Defender % casualties per day		
Old	2.73	7.37
New	3.30	4.66
Attacker % CIA per day		
Old	0.10	0.00
New	0.13	0.00
Defender % CIA per day		
Old	0.80	0.97
New	1.06	0.93
Attacker, % of casualties that are CIA		
Old	2.74	0.00
New	3.65	0.00
Defender, % of casualties that are CIA		
Old	12.21	15.03
New	16.28	16.69

The Syrian encirclement, also at Mt. Hermon, is the only case of an outcome VI attack in which the Israelis are defending. Overall, the data was not significantly changed by removal of the outliers, except for percent casualties per day. This difference is primarily due to smaller unit sizes in these engagements, which is an established phenomenon.

Comparing the Soviet and the Arab-Israeli data still shows some differences. First, the casualty rates for the Arab-Israeli data tend to be higher when the Israelis are the attacker. This is in line with the smaller unit sizes in these engagements. The casualty rate for the Arabs when they attack tends to be lower. This agrees with the theory that the Arab Armies tended to be less stubborn when attacking, as is discussed in the Human Factors Chapter of this report. The percent of Arab casualties that surrender is less than that of the Soviet casualties that surrender. Still, while there are some very clear differences between these two armies, they are roughly comparable in performance. If all the data is combined into a single table, the result is:

Germans/Israelis Attacking						
Number of Engagements	7	7	5	12	11	4
Attacker % casualties per day	0.16	0.73	2.47	1.72	1.49	0.66
Defender % casualties per day	0.13	0.84	2.53	5.02	7.45	41.24
Attacker % CIA per day	0.00	0.00	0.08	0.01	0.00	0.01
Defender % CIA per day	0.04	0.37	0.69	0.92	1.66	39.10
Attacker, % of casualties that are CIA	3.50	1.09	2.35	1.14	0.17	0.70
Defender, % of casualties that are CIA	34.00	42.22	12.50	25.93	22.85	82.38

Germans/Israelis Defending						
	I	II	III	IV	V	VI
Number of Engagements	1	7	14	5	3	1
Attacker % casualties per day	1.01	0.73	3.04	2.22	0.87	10.00
Defender % casualties per day	0.40	0.26	0.98	1.45	4.34	80.00
Attacker % CIA per day	0.34	0.09	11.00	0.19	0.00	0.00
Defender % CIA per day	0.02	0.01	0.03	0.08	0.70	36.36
Attacker, % of casualties that are CIA	33.33	20.65	3.97	7.47	0.00	0.00
Defender, % of casualties that are CIA	4.55	3.58	3.43	6.70	14.59	45.45

C. Recommended Rates

We note that there are two rate sets that can be derived from this data for use in modeling and analysis. One would be used when two opposing forces are both modern, motivated "first-world" armies and when the two armies have similar capabilities. The second would be used when a "less capable" opponent faces a modern, motivated "first-world" army. The "less capable" opponent category would certainly include most "Soviet-style" armies, most armies of the Middle East, and most Third World conventional armies. In fact, the "less capable" table is derived from units that were relatively experienced and motivated, so in fact in many—if not most—cases, the actual difference in performance could be worse.

Table 1: Recommended Rates for Modern, Motivated Armies						
	I	II	III	IV	V	VI
Attacker % CIA per day	0.01	0.01	0.43	0.11	0.02	0.06
Defender % CIA per day	0.02	0.17	0.34	0.92	2.98	30.43
Attacker, % of casualties that are CIA	3.59	3.59	16.21	10.22	2.67	3.06
Defender, % of casualties that are CIA	4.52	14.35	12.98	35.85	47.20	79.70

Table 2: Recommended Rates for Modern, Motivated Armies Attacking Less Capable Armies						
	I	II	III	IV	V	VI
Attacker % CIA per day	0.00	0.00	0.08	0.01	0.00	0.01
Defender % CIA per day	0.04	0.37	0.69	0.92	1.66	39.10
Attacker, % of casualties that are CIA	3.50	1.09	2.35	1.14	0.17	0.70
Defender, % of casualties that are CIA	12.50	12.50	12.50	25.93	22.85	82.38

Table 3: Recommended Rates for Less Capable Armies Attacking Modern, Motivated Armies						
	I	II	III	IV	V	VI
Attacker % CIA per day	0.34	0.09	0.11	0.19	0.00	0.00
Defender % CIA per day	0.02	0.01	0.03	0.08	0.70	36.36
Attacker, % of casualties that are CIA	33.33	20.65	3.97	7.47	0.00	0.00
Defender, % of casualties that are CIA	4.55	3.58	3.43	6.70	14.59	45.45

In Table 2, the "Defender, % of casualties that are CIA" was reduced to 12.50 percent for outcomes I and II. All of the data for this was from cases in which Soviets defended, which tended to produce high percentages. Therefore, it was reduced to match the data found for outcome III.

Note that if the "Less Capable Army" factors in Tables 2 and 3 are used instead of the baseline set in Table 1, then the defender CIA rate will only increase slightly when a "Modern, Motivated Army" is attacking. However, the CIA lost by the "Modern, Motivated Army" will decline. When the "Modern, Motivated Army" is defending, its own rate of surrender will decline while the enemy CIA rate will remain about the same. The end result is that there will not be a significant difference in the CIA rate for the "Less Capable Army" regardless of which table is used. However, the loss to CIA rate for the "Modern, Motivated Army," will decline noticeably. Also note that armies considerably worse than those used to create the "Less Capable" armies tables exist. One should consider any CIA rates derived from these tables to be the minimum expected and plan accordingly. When these rates are applied to CEM, they produce the following values[1]:

CAA Model Category	Rates from WWII Data	Rates for Modern Army	Rates for Lesser Army
Static	0.067	0.015	0.21
Defend	0.669	0.043	0.852
Delay	1.573	0.313	1.274
Attack	0.201	0.019	0.113
Reserve	0.002	0.002	0.004

While these rates are not significantly different for the "Less Capable Army" within each category, what is different is the number of occurrences there are in each category for a given quality force. For example, if the Ardennes and Italian databases are combined and compared to a combined Kursk and Arab-Israeli database we find the following number of occurrences of each degree of success:

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[1] How the rates were calculated:

Static = 0.25 times "limited action, attacker" + 0.25 times "limited attack, attacker" + 0.25 times "limited action, defender" + 0.25 times "limited attack, defender" for each army

Defend (Modern, Motivated Army) = 0.737 times "failed attack" + 0.263 times "attack advances"

Defend (Less Capable Army) = 0.294 times "failed attack" + 0.706 times "attack advances"

Delay (Modern, Motivated Army) = 0.625 times "attack advances" + 0.375 times "defender penetrated"

Delay (Less Capable Army) = 0.522 times "attack advances" + 0.478 times "defender penetrated"

Attack (Modern, Motivated Army) = 0.179 times "failed attack" + 0.429 times "attack advances" + 0.393 times "defender penetrated"

Attack (Less Capable Army) = 0.636 times "failed attack" + 0.227 times "attack advances" + 0.136 times "defender penetrated"

Reserve (Modern, Motivated Army) = 0.100 times "limited action" (defender) and 0.900 times zero (attacker)

Reserve (Less Capable Army) = 0.100 times "limited action" (defender) and 0.900 times zero (attacker)

	Italy/Ardennes Data Attacker is Irrelevant		Kursk/Arab-Israeli Modern Army Attacks		Lesser Army Attacks	
	Count	Percent	Count	Percent	Count	Percent
Limited Action	1	0.68	7	15.22	1	3.23
Limited Attack	7	4.79	7	15.22	7	22.58
Failed Attack	45	30.82	5	10.87	14	45.16
Attack Advances	59	40.41	12	26.09	5	16.13
Defender Penetrated	29	19.86	11	23.91	3	9.68
Defender Enveloped	5	3.42	4	8.70	1	3.23

To normalize the statistics we exclude the "limited actions" and "limited attacks," which were not systematically recorded except for the Kursk data. The result is:

	Italy/Ardennes Data Attacker is Irrelevant		Kursk/Arab-Israeli Modern Army Attacks		Lesser Army Attacks	
	Count	Percent	Count	Percent	Count	Percent
Failed Attack	45	32.61	5	15.63	14	60.87
Attack Advances	59	42.75	12	37.50	5	21.74
Defender Penetrated	29	21.01	11	34.38	3	13.04
Defender Enveloped	5	3.62	4	12.50	1	4.35

While this sampling of battles is not randomly selected, and therefore has inherent bias, it is felt to be a reasonable representation of the mix of combat and engagements that the units in these campaigns and engagements underwent. Drawing tentative conclusions from this data is reasonable since it is not a deliberately biased selection.

What is clear is that between modern armies with roughly similar capabilities, attacks will fail about one-third of the time and will succeed (penetration or envelopment) about one-quarter of the time.

If a modern army faces a lesser army, then one would expect to see the attack fail about one-sixth of the time and succeed almost one-half of the time (46.88 percent).

Thus, facing a less capable army would reduce the chance of failure for an attack by a factor of two (or will increase the chance of success by around 25 percent), and would also increase the chance of a penetration or envelopment by a factor of two.

If a lesser army faces a modern army, then one would expect to see the attack fail about 60 percent of the time (or the chance for success is reduced by 40 percent), or almost twice as often.

The chance for a penetration or envelopment is also reduced noticeably in this case.

These statistics are measured against the baseline example of two "Modern, Motivated armies" facing each other. When the outcomes for the "modern army" and the "less capable" army are directly compared the differences are more pronounced. In this case the chance of failure for the "modern army" is one-quarter of that for the "lesser army," and the chance of achieving a penetration or envelopment is about two-and-one-half times as likely.

These statistics do not address force ratios. As was discussed earlier, the force ratio for the "modern army" tends to be lower when attacking. However, the "less capable army" is often forced to attack at higher odds to guarantee success. This further magnifies the differences between these forces, even though the measurable difference in the daily capture rate is insignificant.

This highlights the fact that a simple table measuring capture rates based upon "human factors" alone is insufficient. Many factors, **including** human factors, force ratios, and others must be addressed.

One of the significant results of the differences in the capabilities of armies is that the more capable army tends to win more often, at lower odds, and the result of the victory tends to be more significant.

If the Operations Research community wishes to properly represent the impact of human factors on capture rates, then it needs the ability to properly represent human factors within appropriate elements of the combat model utilized.

D. Force Mix (Armor)

Another element (besides posture and outcome) that clearly has an impact on capture rates is the force mix. Force mix is measured by the presence of main battle tanks on the battlefield. Therefore, the presence of armor on the battlefield does have an impact on EPW rates.

In this study armor is measured as the number of main battle tanks per 1,000 troops. We then analyzed the results by looking at the total number captured and the percent of enemy strength captured. As a reminder, the definitions are:

Infantry:	2 or less main battle tanks per 1,000 troops
Armor Supported:	2 to 8 main battle tanks per 1,000 troops
Armor Heavy:	8 or more main battle tanks per 1,000 troops

Note: as there are two sides to the engagement, the number of data points is over 80.

Refer to the tables on the following page. In aggregate the difference in average captured by posture ranges from 3.6 to 6.1 (with an overall weighted average of 6, an average of 216 for the attacker versus 36 for the defender). The difference by force mix from infantry to armor supported is 2.4 for the defender and 3.9 for the attacker. The difference by force mix from armor supported to armor heavy is 2.0 for the defender and 1.6 for the attacker. The overall shift from infantry to armor heavy in average capture rates is 4.8 for the defender and 6.4 for the attacker. These figures imply that the impact of force mix on combat is roughly equal to, or slightly less than, the impact of posture on combat, and are shown in the tables on the next page.

First we attempted to examine all of the Arab-Israeli data (34 engagements). This data was skewed by a number of engagements that appeared to be outliers. Of the nine infantry engagements, the number of CIA ranged from 0 to 20 in eight of the cases, while in the ninth there were 864 CIA,

Total CIA by Armor Mix	Cases	Average No. Captured
Arab-Israeli Engagements		
Armor Heavy	45	181
Armor Supported	14	372
Infantry	9	98
Falklands Engagements*		
Armor Heavy	2	61
Armor Supported	0	0
Infantry	10	46
Persian Gulf Engagements		
Armor Heavy	7	1,233
Armor Supported	1	4,000
Infantry	1	1269

*Light tanks only; no MBTs were deployed to the Falklands

Total CIA by Armor Mix and by Attacker or Defender		Cases	Average No. Captured
Arab-Israeli War Engagements			
Armor Heavy	Attacker	22	354
	Defender	23	15
Armor Supported	Attacker	10	521
	Defender	4	0
Infantry	Attacker	2	442
	Defender	7	0
Falklands War Engagements			
Armor Heavy	Attacker	2	61
	Defender	0	-
Armor Supported	Attacker	0	-
	Defender	0	-
Infantry	Attacker	5	92
	Defender	7	0
Persian Gulf War Engagements			
Armor Heavy	Attacker	6	1,439
	Defender	1	0
Armor Supported	Attacker	1	4,000
	Defender	0	0
Infantry	Attacker	1	1269
	Defender	0	0

giving an average of 98 CIA for the nine. If the ninth engagement is excluded the average number of CIA would be 3. This data is further skewed because the infantry was only on the offensive in one of the nine cases.

For the 14 armor supported engagements, the number of CIA ranged from 0 to 195 in twelve of the cases, in the remaining two cases there were 1,500 and 3,300 CIA. The average was 372 CIA in all 14 cases. The highest number CIA is found in three cases from the 1956 war. If the highest of these is excluded the average CIA is 146 and, if the highest two are excluded, the average CIA is 34. It appears that if these two cases were excluded then a more cohesive data set would result.

Some problems also were found with the armor heavy engagements, although they were not caused by the 1956 data (where there were only two armor heavy cases, with CIA of 100 and 0). The CIA in the armor heavy cases ranged from 0 to 500 in 43 and in the two highest CIA was 1,200 and 5,500. The average was 181 CIA. If the highest is excluded then the average is 60 CIA, while excluding the two highest results in an average of 33 CIA. This is summarized beginning on the next page.

Arab-Israeli Wars				
	Average Number Captured			
	Cases	All Data	Less High Point	Less Second High Point
Armor Heavy	45	181	60	33
Armor Supported	14	372	146	34
Infantry	9	98	3	0

However, one is hesitant to draw any conclusions from this data manipulation. Again, the issue appears to be the difference in human factors. No pattern can be found except for the human factor difference between the attacker and defender, regardless of force mix, when all the data is examined. However, there are two major problems with this data. First, most of the 1973 engagements (and Kerama) are Armor Heavy on both sides (43 out of 56, or 77 percent). There are only eight cases of armor supported and five cases of infantry engagements. We have surmised that the Egyptian Army in 1956 was relatively poorer than it was in 1973 and it is these armor supported and infantry engagements that are generating the odd figures. If they are excluded, then a more consistent data set is obtained. Still, this data set has too few cases. To illustrate:

Arab-Israeli 1973 Engagements		
	Cases	Avg No Captured
Armor Heavy	45	187
Armor Supported	8	20
Infantry	3	40

The armor heavy engagements contain two of the possible data outliers (that are not found in the armor supported and infantry cases). If these two outliers are removed, then the average CIA is reduced to 32. This appears to show some improvement for the armor heavy cases over the armor supported cases, however since there are a small number of cases in these categories, confidence in the data is low. If the two data point outliers are excluded then:

Arab-Israeli 1973 War, Less Outliers		
	Cases	Avg No Captured
Armor Heavy	45	32
Armor Supported	8	20
Infantry	3	4

An attempt to divide this data by attacker and defender (less the two outlying data points) produces the following:

Arab-Israeli 1973 War by Attacker and Defender Less Outliers			
		Cases	Avg No Captured
Armor Heavy	Attacker	19	52
	Defender	22	15
Armor Supported	Attacker	6	27
	Defender	2	0
Infantry	Attacker	1	20
	Defender	4	0

Now lets look at the percent captured per day. This produces the following data (again 1973 data less the two outliers):

Arab-Israeli 1973 War, Percent CIA per Day Less Outliers			
		Cases	Average Daily Percent of Enemy CIA
Armor Heavy	Attacker	19	0.37
	Defender	22	0.05
Armor Supported	Attacker	6	0.26
	Defender	2	0
Infantry	Attacker	1	36.36 (0)
	Defender	4	0

Again, by purging an outlier (in this case Mt. Hermon, an infantry attack where the defender had only 55 men and was attacked by 500, losing 20 men surrendered) the result again is a table that is in line with that derived from the World War II data.

Finally, in an attempt to address differences between armies, we separated our data points into Israeli and Arab cases (keeping in mind that we have now removed 3 "outliers" from a data set of 56).

Israeli Cases			
		Cases	Average Daily Percent of Enemy CIA
Armor Heavy	Attacker	10	0.48
	Defender	12	0.05
Armor Supported	Attacker	3	0.46
	Defender	0	0
Infantry	Attacker	0	0
	Defender	0	0
Arab Cases			
		Cases	Average Daily Percent of Enemy CIA
Armor Heavy	Attacker	9	0.24
	Defender	10	0.04
Armor Supported	Attacker	3	0.05
	Defender	2	0
Infantry	Attacker	0	0
	Defender	4	0

While this data contains too few points to reach a decisive and significant conclusion, we must consider the reason for examining this smaller set of post-World War II data. First, we are checking the data to see if it demonstrates any change or revolution in warfare since World War II. Second, we are attempting to determine if this data can be used in conjunction with World War II data. Third, we are attempting to cross check it to the World War II data.

Let us go back to the conclusions that were drawn in the Phase I & II Report regarding the effect of armor on the CIA rate:

> *The difference between armor heavy and infantry is by a factor of 5.75 times (figures as an arithmetic mean of the 41 armor heavy forces compared to the 113 infantry forces), or a factor of 6.4 for the attacker, and 4.8 for the defender. As percent per day CIA, the overall difference is by a factor of 17.7, with a factor of 17.3 for the attacker and 3.6 for the defender. Again, as a general rule of thumb, the percent losses for the force opposing an attacking armor*

heavy force will be 10 times higher than the force opposing an infantry force, with the actual losses (in numbers) being about 5 times higher...

The impact of force mix on capture rates is more significant for the attacker than for the defender. The effect on the attacker of the defender's force mix ranges from a factor of 2 (the Ardennes data) to around 4.8. As a general rule of thumb, the percent losses for the force opposing a defender armor heavy force will be about 4 times higher than a force opposing an infantry force, with the actual losses (in numbers) being in the same range.

Because the number of post-World War II data points in some categories is small, we cannot reach solid conclusions. However, we can indicate whether the data supports or contradicts these conclusions.

The post-World War II data does not support the concept of a revolution in warfare.

The degree of difference in the actual number of CIA varies by a factor of eight between infantry and armor heavy. This is not out of line with the World War II data. Furthermore, the average number of CIA tends to be much lower than what was found in the World War II data, as is shown below:

Average Number Captured		WWII Data	1973 Data
Armor Heavy	Attacker	395	52
	Defender	81	15
Armor Supported	Attacker	243	27
	Defender	40	0
Infantry	Attacker	62	20
	Defender	17	0

While the numbers are very different, the pattern still remains. The same comparison can be done looking at Average Daily Percent Captured:

Average Percent Daily Captured		WWII Data	1973 Data
Armor Heavy	Attacker	5.03	0.37
	Defender	0.32	0.05
Armor Supported	Attacker	1.59	0.26
	Defender	0.2	0
Infantry	Attacker	0.29	0
	Defender	0.09	0

Again, very different numbers, but the pattern remains. The capture rates are in fact, not that far out of line with the Italian Campaign data. Just for comparison:

Average Percent Daily Captured		Italian Campaign WWII Data	1973 Data
Armor Heavy	Attacker	0.87	0.37
	Defender	0.44	0.05
Armor Supported	Attacker	0.63	0.26
	Defender	0.27	0
Infantry	Attacker	0.35	0
	Defender	0.16	0

Keep in mind that the World War II data is based upon 389 data points, the World War II Italian Campaign data is based upon 150 data points, while the Arab-Israeli data uses just 53 data points. This data base suffers from a lack of robustness.

First, what this shows is that the overall capture rates are much lower in the Arab-Israeli than the World War II engagements.

This is actually also true for the casualty rates. While one could conclude that this might show that changes in warfare is further reducing casualties, in this particular case, it is almost certainly being driven by the casualty sensitiveness of both Israeli and Arab armies.

Second, the post-World War II data can be mixed in with World War II data. However, this answer is tentative and it is not recommended.

As shown in the discussion on human factors, there is a real difference in relative combat performance between the two sides, and only the Arab data could be mixed with the Soviet data, which we have surmised shows similar levels of performance.

Third, this data is a useful cross check of the World War II data.

The numbers do not match but are similar, and the pattern is clear and consistent. Armor heavy forces tend to generate more captures, with the difference being more noticeable for the attacker than the defender.

E. Impact of Morale

The final issue is the impact of morale on the capture rate. The Phase I & II Final Report tentatively concluded that:

> *If there is a relative casualty effectiveness disparity between two armies on the order of magnitude of 3, then there will be a disparity in the capture rates by an order of magnitude of 10, and this may well be reflected by decreasing the capture rates of the side with the higher more.*

Kursk Data

The Kursk data shows the following:

Average Percent Casualties per Day						
Engagement Outcomes	# German Attacks	# Soviet Attacks	German Attacks	Soviet Attacks	German Defense	Soviet Defense
I - VI	31	-	0.80	-	-	6.52
I - IV	24	18	0.78	2.39	0.71	2.36
II - IV	24	17	1.04	2.47	0.73	3.28
III - IV	10	11	1.25	3.38	1.07	4.54
IV	9	3	1.30	3.54	1.03	5.35

Or to express this as a direct comparison:

Casualty Ratios		
Engagement Outcomes	Soviet vs. German Attacks	German vs. Soviet Attacks
I - IV	3.06	3.32
II - IV	2.38	4.49
III - IV	2.70	4.24
IV	2.72	5.19

As the percent of each type of outcome weighs the data, this can also be calculated based upon weighing all the engagements evenly (i.e. Outcome I, II, III, and IV engagements count the same, regardless of the number). A possible reason to examine these engagements without weighting them is because of the clear performance differences between the different sides. Since the less capable force has a greater percent of failed attacks and a lesser percent of penetrations and envelopments, weighing the results by the number of engagements of each type might make the differences look greater than they really are. Below is the same comparison with all outcome categories weighted equally.

Average Percent Casualties per Day, Outcomes Weighted Equally				
Engagement Outcomes	German Attacks	Soviet Attacks	German Defense	Soviet Defense
I - VI	0.78	-	-	9.00
I - IV	0.76	2.17	0.67	2.02
II - IV	0.95	2.56	0.75	2.64
III - IV	1.07	3.43	0.99	3.55
IV	1.30	3.54	1.03	5.35

This results in the following ratios:

Casualty Ratios		
Engagement Outcomes	Soviet vs. German Attacks	Soviet vs. German Defense
I - IV	2.85	3.01
II - IV	2.69	3.52
III - IV	3.21	3.58
IV	2.78	5.19

Any way the data is sliced it appears that there is roughly a three-to-one casualty effectiveness advantage on the part of the Germans when comparing percent casualties per day. This advantage is in both the offense and the defense.

Using the exact same comparisons the percent captured in action per day is:

Average Percent Captured in Action per Day					
Engagement Outcomes	# German Attacks	# Soviet Attacks	German Attacks	Soviet Attacks	German Defense
I - VI	31	-	0.00	-	-
I - IV	24	18	0.00	0.16	0.03
II - IV	24	17	0.01	0.15	0.03
III - IV	10	11	0.01	0.17	0.05
IV	9	3	0.01	0.31	0.06

Or to express this as a direct comparison:

Casualty Ratios		
Engagement Outcomes	Soviet vs German Attacks	Soviet vs German Defense
I - IV	-	18
II - IV	15	25
III - IV	17	20
IV	31	18

As the percent of each type of outcome weighs the data, this can also be calculated based upon weighing all the engagements evenly (i.e., Outcome I, II, III and IV engagements count the same, regardless of the number of them).

Average Percent Captured in Action per Day, Outcomes Weighted Equally				
Engagement Outcomes	German Attacks	Soviet Attacks	German Defense	Soviet Defense
I - VI	0.01	-	-	6.91
I - IV	0.01	0.22	0.03	0.42
II - IV	0.01	0.18	0.04	0.57
III - IV	0.01	0.22	0.05	0.67
IV	0.01	0.31	0.06	1.09

This results in the following ratios:

Casualty Ratios		
Engagement Outcomes	Soviet vs German Attacks	Soviet vs German Defense
I - IV	22	14
II - IV	18	14
III - IV	22	13
IV	31	18

Any way the data is sliced it looks like there is roughly a twenty-to-one captured in action advantage on the part of the Germans (when comparing percent of own troops captured per day). This advantage is in both the offense and the defense.

This differs somewhat from the conclusion of the Phase I & II Final Report, which shows that a combat effectiveness advantage of "3" results in about 10 times as many captured. This is due to the captured in action being measured as a percent of the total force in the Phase I & II Final Report. As it was compared to a relative combat effectiveness measured from a percent of each engagement, then there is a little bit of apples and oranges being mixed here. As such, the math does not exactly match with the slightly more rigorous analysis done in this section of the report. Suffice it to say that for the Soviet data, if there is a casualty effectiveness difference, then there will be a much greater difference in captures between the two forces. The question is whether this hypothesis can also be demonstrated using the Arab-Israeli Data.

Arab-Israeli Data

A similar comparison with the 1973 Arab-Israeli data shows the following:

Average Percent Casualties per Day					
Engagement Outcomes	# Israeli Attacks	# Arab Attacks	Israeli Attacks	Arab Attacks	Israeli Defense
II - VI	-	13	-	-	2.25
III - VI	15	12	2.24	2.42	8.66
III - V	14	11	2.37	1.73	1.66
III - IV	7	8	2.92	2.06	1.29
III	4	6	2.88	2.66	1.03
IV	3	2	2.98	0.24	2.08

Or to express this as a direct comparison:

Casualty Ratios		
Engagement Outcomes	Arab vs Israeli Attacks	Arab vs Israeli Defense
III - VI	1.08	0.96
III - V	0.73	4.08
III - IV	0.71	2.55
III	0.92	2.65
IV	0.08	2.08

As the percent of each type of outcome weighs the data, this can also be calculated based upon weighing all the engagements evenly (i.e., Outcome I, II, III, and IV engagements count the same, regardless of the number of them).

Average Percent Casualties per Day, Outcomes Weighted Equally				
Engagement Outcomes	Israeli Attacks	Arab Attacks	Israeli Defense	Arab Defense
II - VI	-	-	2.81	15.51
III - VI	2.03	3.44	21.86	16.03
III - V	2.56	1.26	2.48	4.69
III - IV	2.93	1.45	1.56	3.38
III	2.88	2.66	1.03	2.73
IV	2.98	0.24	2.08	4.03

This results in the following comparison:

Casualty Ratios		
Engagement Outcomes	Arab vs Israeli Attacks	Arab vs Israeli Defense
III - VI	1.69	0.73
III - V	0.49	1.89
III - IV	0.40	2.17
III	0.92	2.65
IV	0.08	2.08

The biggest problem with the Arab-Israeli data is that a lot of the Arab attacks are at high odds. They executed over half of their attacks at odds greater than 3 to 1 (7 out of 13). In contrast, the Soviets

made only one attack at odds greater than 3 to 1 (1 out of 18). The Germans made only two (2 out of 31). When an attack is at three-to-one odds, and the attacker suffers the same percent of casualties as the defender, then the attackers actual losses are three times as many. This makes it difficult to directly compare the Israeli loss percentage when attacking (they never attacked at more than 3 to 1) with the Arabs. The average force ratio of an Israeli attack was 1.14 to 1 while the Arab was 4.44 to 1. In contrast, at Kursk the average force ratio for a German attack was 1.78 to 1 while the average force ratio for the Soviets was 1.72 to 1. Overall, this allows one to directly compare the Soviet and German casualties and capture rates as they tend to occur under similar conditions and with similar force ratios. As the Arabs are attacking at much higher force ratios, and the Israeli are defending at much lower force ratios, then the math is not as "clean." Still, let us look at the capture rate differences:

Average Percent Captured in Action per Day					
Engagement Outcomes	Number of Cases	Israeli Attacks	Arab Attacks	Israeli Defense	Arab Defense
II - VI	15/13	-	-	0.04	2.98
III - VI	15/12	0.03	0.05	3.23	3.61
III - V	14/11	0.03	0.05	0.21	0.59
III - IV	7/8	0.06	0.07	0.03	0.21
III	4/6	0.10	0.09	0.01	0.80
IV	3/2	0.00	0.00	0.10	0.39

Or to express this as a direct comparison:

Casualty Ratios		
Engagement Outcomes	Arab vs Israeli Attacks	Arab vs Israeli Defenses
III - VI	1.67	1.12
III - V	1.67	2.81
III - IV	1.17	7.00
III	0.90	80.00
IV	-	3.90

As the percent of each type of outcome weighs the data, this can also be calculated based upon weighing all the engagements evenly (i.e. Outcome I, II, III and IV engagements count the same, regardless of the number of them).

Average Percent Captured in Action per Day, Outcomes Weighted Equally				
Engagement Outcomes	Israeli Attacks	Arab Attacks	Israeli Defense	Arab Defense
II - VI	-	-	0.02	7.44
III - VI	0.03	0.02	9.29	12.00
III - V	0.03	0.03	0.27	0.72
III - IV	0.05	0.05	0.06	0.60
III	0.10	0.09	0.01	0.80
IV	0.00	0.00	0.10	0.39

This results in the following comparison:

Casualty Ratios		
Engagement Outcomes	Arab vs. Israeli Attacks	Arab vs. Israeli Defenses
III - VI	0.67	1.29
III - V	1.00	2.67
III - IV	1.00	10.00
III	0.90	80.00
IV	0.08	3.90

F. Conclusion

The data on the percent captured in action show the same tendency as the data on the percent of casualties, with roughly the same percent losses for the attacker. The Arabs tend to take a similarly higher percent of captured as they do in losses (relative to the Israelis). From this comparison, three very definite statements can be made.

• The conclusion in the Phase I & II Final Report concerning the relationship between relative casualty effectiveness and surrender rates is not correct, or it is a relationship that only applies to the Soviet Armed Force at Kursk in 1943.

• The conclusion in the Phase I & II Final Report that "it is clear that considerably more engagements need to be developed and analyzed to strengthen, or disprove this hypothesis" is clearly proven to be a valid.

• There is a clear difference in the nature of the poor performance of the Soviet Army in 1943 and that of the Arab Armies in 1973.

The differences mentioned in the third point can best be summarized as:

a. The overall relative competency of the two armies was similar.

b. The Soviet Army had higher surrender rates, implying worse morale and unit cohesion than the Arab Armies.

c. The Soviet Armies were more willing to take casualties and push low odds attacks, implying higher motivation (whether this meant higher motivation among the men or the commissars is not known).

d. Since the technology of the opposing armies was similar, then any other differences must be due to human factors.

e. Certain human factors do not appear to be at issue. This includes experience, intelligence (including interpretation), momentum, the effect of surprise, logistical systems, and doctrine (the Arabs used Soviet style doctrine).

f. This implies that the weakness in the Arab Armies was not due to primarily morale and cohesion, but had more to due with other factors. These other factors include leadership, generalship, training, initiative, organizational habits and even cultural differences.

g. This implies that the Soviet Army in 1943 was stronger in one or more of the six human factors listed above than were the Arabs, and that this partially compensated for the inferior morale and unit cohesion relative to the Arab armies.

For reference, The Dupuy Institute considers the following factors to be part of "human factors."

Leadership	Momentum
Generalship	Initiative
Training	Doctrine
Experience	The Effects of Surprise
Morale	Logistical Systems
Motivation	Organizational Habits
Cohesion	Cultural Differences
Intelligence (including interpretation)	

Chapter
7

STUDY CONCLUSIONS

A. Summary of the Phase I and II Final Report Conclusions

- **Outcome is a Significant Determinant of EPW Rates**
- Effect is by a factor of 10 or greater, and can rise to a factor of 100 or greater with penetrations and envelopments
- **Being Attacker or Defender is a Significant Determinant of EPW Rates**
- Effect is by a factor of 10 or greater
- **Force Mix is a Significant Determinant of EPW Rates**
- Effect is by a factor or 10 or greater for the attacker
- Effect is by a factor of around 4 for the defender
- **Morale (Being Soviet) is a Significant Determinant of EPW Rates**
- Effect is by a factor of around 10
- Historically, there have been armies much worse than the Soviet Army in 1943

B. Summary of the Phase III Conclusions

1. Outcome is a significant determinant of EPW Rates. This is still the case in the post-World War II data. Furthermore, the order of magnitude appears to be around the same. In the case of the World War II data, the CIA loss rate for the attacker changed from 0.43 percent CIA per day for a failed attack to 0.02 percent for a penetration. For the defender, the shift in the CIA rate went from 0.34 percent when an attack failed, to 2.98 percent when penetrated, and 30.43 percent when enveloped.

The post-World War II data did not always show the same degree of change. When the Israelis, U.S., French, and British attacked their CIA loss rates were so low that they were insignificant (usually the figure was around 0.01 percent for all categories). The data on Arab attacks is too spotty to draw conclusions from it.

However, for the defenders the change did occur at the same order of magnitude. For example, when the Arabs defended in 1973, they suffered from 0.39 percent to 0.80 percent captured per day for successful and failed attack, to 0.97 percent when penetrated, and 45.83 percent per day when enveloped. When the Israelis defended, they suffered from 0.01 percent per day for successful and failed attacks, to 0.70 percent per day when penetrated, and 36.36 percent per day when enveloped.

Therefore, the post-World War II data does not show any changes in this conclusion due to changes in warfare, the order of magnitude of the change remains the same, and the post-WWII data does provide further confirmation for these conclusions.

2. Being the Attacker or Defender is a Significant Determinant of EPW Rates. This is still the case with the post-WWII data. When the Israelis, U.S., French, or British attacked, the CIA rate per day was between zero and 0.01 percent per day. When the Israelis defended the CIA rate was 0.01 percent for failed attacks, rising to 0.10 percent for successful attacks, rising to 0.70 percent when penetrated, and 36.36 percent when enveloped.

As a comparison, the 1973 data shows that when the Arabs attacked, the CIA rate per day ranged from a minimum of zero to between 0.01 and 0.09 percent depending on the outcome. When they defended, the Arabs lost 0.39 percent CIA for successful attacks, rising to 0.97 percent when penetrated, and 45.83 percent when enveloped.

Therefore, an analysis of the post-World War II data does not show any change to this conclusion due to changes in warfare. The order of magnitude of the change remains the same and the post-World War II data does provide additional confirmation for these conclusions.

3. Force Mix is a Significant Determinant of EPW Rates. Unfortunately, due to the nature of the combat, the post-World War II data was less help here. This is discussed in some depth in the analysis. From the analysis we concluded that the data does not indicate that a revolution in warfare has occurred. The degree by which the data varies between force mix is not inconsistent with the World War II data. While the numbers are very different, the pattern remains. The biggest problem with analysis using this data was the small size of the sample.

4. Morale (Being Soviet) is a Significant Determinant of EPW Rates. This clearly was a factor in all the post-World War II databases. It certainly was a dominant factor in the Gulf War engagements. It would appear that the relative combat effectiveness of the Germans versus the Soviets was similar to the relative combat effectiveness of the Israelis versus the Arabs. This difference in relative combat effectiveness generated differences in relative capture rates. The Arabs tended to lose more men as CIA than did the Israelis. The Arabs CIA loss rate when attacking was similar to the Israeli CIA loss rate when attacking. However, the Arabs attacked only at much higher odds, which resulted in as many as three times as many Arabs being captured as Israelis. The Arab CIA loss rate when defending was about three times higher (or more) than the Israelis CIA loss rate when defending.

This does differ in detail from the World War II Soviet data, where CIA loss rate is 10 to 20 times higher and is a result of a similar difference in relative casualty effectiveness.

As such, at least through 1982, all the differences in outcome can be explained by morale. The effect is by a factor of at least three (as opposed to 10 as in the Phase I and II Report) and for some armies (Soviet Army in 1943) the effect can be by a factor of up to 10. Also, there are many armies that are much worse than the Soviet Army of 1943 or the Arab Armies of 1973. In the worse case we found, which was the Iraqi Army of 1991, the difference can be by a factor of well over 100.

Therefore, the post-World War II data does not show any change in this conclusion due to changes in warfare. However, the order of magnitude of the change has been reduced to a factor of 3 to 10, depending on the army; in the worst case, up to 100. The post-WWII data does provide further confirmation for these conclusions.

C. Reasons for Examining the Post-World War II Data

1. To determine if there were changes in warfare over time that had an impact on the capture rate. The answer to this is very clearly NO, at least up through 1982. In the Gulf War in 1991, changes in warfare cannot be shown to be a specific cause for the high Iraqi surrender rate. The rate was clearly a result of abysmally poor morale. Whether a revolution or evolution in warfare, other hu-

man factors, the situation, or the sheer intensity of the aerial bombardment was the cause for this abysmal morale state cannot be determined without further study.

2. To determine if post-World War II data could be mixed with the World War II data. Because human factors played a significant role in all of the post-World War II conflicts examined (1956 Arab-Israeli War, 1973 Arab-Israeli War, Falklands, and the Gulf War), the degree of difference between the opposing forces varied widely. Considering that the World War II data is very cohesive, mixing the two is not advisable. Since no revolution in warfare is visible in the data, then the use of World War II data is applicable to modern warfare, except in situations where the U.S. Air Force is free to bomb an exposed opponent for 30 days or more. If that is the assumed scenario for all future conflicts, then further research must be done to support it.

There are further problems with mixing the post-World War II data with the World War II data. First, most of the failed attacks involved the "less capable army," while most of the successful attacks involved the "modern, motivated army." Second, the quality of research for the post-World War II data, because of the inability to access the unit records of both sides (and in most cases for neither side) is, by its nature, less reliable. Third, the unit sizes in the post-World War II data tend to be smaller, resulting in higher casualty rates and captures rates when compared to the World War II data.

Therefore, while we do provide composite tables (below) that mix the World War II and post-World War II data, their use is not recommended.

3. To serve as a crosscheck to the original World War II data. The post-World War II data served as an admirable independent crosscheck of the analysis done with the World War II data. In fact, it confirmed all four major conclusions; confirmed or at least supported the CIA values found in the data; and displayed a consistent pattern of behavior relative to the World War II data. The only conclusion contradicted was that considering the mathematical relationship between casualties and captured in action for less capable forces.

Summation Table (Compiled Data from World War II)	I	II	III	IV	V	VI
Number of engagements	9	20	54	71	33	8
Attacker % casualties per day	0.24	0.80	2.98	1.20	0.83	1.20
Defender % casualties per day	0.20	0.80	2.62	2.96	6.40	36.00
Attacker % CIA per day	0.05	0.04	0.43	0.11	0.02	0.06
Defender % CIA per day	0.04	0.24	0.34	0.92	2.98	30.43
Attacker, % of losses that are CIA	17.54	9.56	16.21	10.22	2.67	3.06
Defender, % of losses that are CIA	27.45	24.10	12.98	35.85	47.20	79.70

(Table 7 from page 77, EPW Phase I and II Final Report)

Summation Table (Compiled Data from post-World War II)	I	II	III	IV	V	VI
Number of engagements	0	1	14	8	33	5
Attacker % casualties per day	0.26	3.20	1.60	1.36	2.54	-
Defender % casualties per day	0.12	2.80	4.83	15.10	49.48	-
Attacker % CIA per day	-	0.01	1.28	0.00	0.00	0.00
Defender % CIA per day	-	0.01	0.46	1.01	9.85	30.86
Attacker, % of losses that are CIA	4.29	29.83	0.00	0.00	0.00	-
Defender, % of losses that are CIA	10.82	9.83	23.34	60.61	87.10	-

Summation (combination of World War II and post-World War II Data)						
	I	II	III	IV	V	VI
Number of engagements	9	21	68	79	66	13
Attacker % casualties per day	0.24	0.77	3.03	1.24	1.10	1.72
Defender % casualties per day	0.20	0.77	2.66	3.15	10.75	41.18
Attacker % CIA per day	0.05	0.04	0.61	0.10	0.01	0.04
Defender % CIA per day	0.04	0.23	0.36	0.93	6.42	30.60
Attacker, % of losses that are CIA	17.54	9.31	19.01	9.19	1.34	1.88
Defender, % of losses that are CIA	27.45	23.47	12.33	34.58	53.91	82.55

The primary impact of mixing the two data sets is to increase the CIA rate for the defender. For outcomes I and II, the data hardly changed, as the post-World War II data has only one such result. For outcome III engagements, the attacker CIA loss went up considerably, due to the large number of Iraqi and Arab failed attacks among the 14 cases (four were Iraqi and six were Arab). The defender rate hardly changed. Outcome IV was almost unchanged. However, it did slightly favor the attacker at the expense of the defender. This is due to the small number of Outcome IV engagements in the post-World War II data. Outcome V changed significantly for the defender, considerably increasing the defender CIA loss rate. This is because all of the Falklands and many of the Gulf War engagements were Outcome V, clearly distorting the result. Outcome VI basically resulted in a lower attacker CIA rate.

This combined World War II and post-World War II table is not recommended for use. Instead, original table from the Phase I & II Report should be used.

Phase I & II Summary Table						
	I	II	III	IV	V	VI
Attacker % CIA per day	0.01	0.01	0.43	0.11	0.02	0.06
Defender % CIA per day	0.02	0.17	0.34	0.92	2.98	30.43
Attacker, % of losses that are CIA	3.59	3.59	16.21	10.22	2.67	3.06
Defender, % of losses that are CIA	4.52	14.35	12.98	35.85	47.20	79.70

(Table 10 from page 90, EPW Phase I and II Final Report)

D. Conclusions

- **The recommended table from the Phase I and II Final Report should be used.**

- **This recommended table is entirely applicable for post-World War II situations.**

- **There is no strong evidence that a revolution or evolution in warfare, or other changes in warfare, have had an impact on EPW capture rates.**

- **If the Army wishes to model the effect of the difference in combat effectiveness on enemy prisoner of war capture rates, then the models must be corrected, and they must address human factors.** Simply using different sets of tables cannot effectively model combat effectiveness and human factors.

- **There may be an impact of modern airpower on combat as it significantly reduces morale and combat effectiveness through sustained bombardment, as in the Gulf War.** This can only be confirmed by further study of air and artillery bombardments and its effect.

- **This can be the basis for a regression model that addresses and assigns weights to posture, outcome, force mix and morale, and how they effect enemy prisoner of war CIA rates.** To create such a model—one that has high confidence value—will require more data points.

Chapter
8

Final Comments

Between this report, the Phase I & II Final Report, the Report on the Medical Burden caused by EPW, and the Report on Enemy Prisoner of War Capture Rates in Small Scale Contingency Operations, we have probably reached the point of diminishing returns on this subject. Certainly, further data could be collected and analyzed. The two most important areas that still need to be addressed are the effects of airpower and artillery on capture rates. With an expanded database it would eventually be possible to create a regression model that would address the impact of these and posture, outcome, force mix, and morale on EPW capture rates. With even further exploration, one could also address different combat environments (desert, jungle, amphibious, mountain, and urban warfare). Major and minor insurgencies also should be more fully addressed. Furthermore, the issue of civilian internees has not been examined.

Still, what is clearly being systematically shown is that the real issues to be pursued are the battle outcomes and the morale of the opposing forces. At this point, spending further effort to create more exacting and sophisticated charts measuring capture rates is of little value if they are more sophisticated than the models that are using them.

It is clear that what really needs to be done is that the models must be revised so that they properly address human factors. This study, in addition to providing enemy prisoner of war capture rates, has also shown that human factors can be measured, and in fact, this study has shown some discrimination in identifying what those actual factors might be. This work provides a solid basis to further explore the issue that would allow the community to come up with a methodology for measuring and modeling human factors.

The other use of this work is to develop databases to properly address the other elements of combat, in particular related issues such as casualty rates, conditions of combat, and so on. The databases developed or expanded as a result of this project are basic research tools that can answer a wide range of analytical questions. This needs to be explored further and will in fact generate more significant conclusions that those that have come out of these studies.

In fact, of immediate interest, and work that should be explored further, is the differences in relative combat effectiveness of Arab armies over time and as compared to Soviet armies. Such comparisons, although based upon assumptions concerning the relative combat effectiveness of the German Army and Israeli Army, may allow us to better understand the characteristics and differences between armies. Even this limited work has allowed us to not only produce overall measurements of combat effectiveness, but to see how it can be parsed into possible components and to what degree that each component influences the behavior of each army. Only a few of the Arab-Israeli engagements we have assembled were used for this study, due to a lack of CIA data. Since we have considerably more Soviet material that can be used for assembling engagements (from the Kursk Data Base) such a comparison could be done based upon 64 Arab-Israeli engagements and some 120 German-

Soviet engagements (compared to the current analysis of 28 Arab-Israeli and 49 German-Soviet engagements).

Lastly, this work has again confirmed the value and relevance of using World War II experience in operations research and analysis. It is apparent that if a "revolution in warfare" exists, it may be more accurately described as an "evolution in warfare." As such, World War II remains the best source of reliable data on combat and will retain its relevance for the near future.

Appendix

I

1956 Suez War Engagement Data

Arab-Israeli War Engagements

Engagement Number	Engagement Name	Duration (in Days)	Attacker Total Strength	Defender Total Strength	[illegible]	[illegible]	[illegible]	Defender Total Cas	Attacker MIA	Defender MIA
	1956 SUEZ WAR									
16000	Abu Ageila	3	16,000	3,500	72	22	581	620	0	0
16010	Mitla Pass	3	3,000	2,000	0	0	176	750	0	0
16020	Central Sinai	3	3,000	4,000	0	88	100	450	0	100
16030	Rafah	2	13,000	6,000	84	40	101	3,000	0	1,500
16040	Gaza	1	3,500	5,000	0	0	76	5,000	0	3,500
16050	Sharm el-Sheikh	3	1,800	995	0		42	995	0	864
	1968-1973 WAR OF ATTRITION									
17200	Kerama	1	11,940	16,168	120	60	100	497	3	128

Engagement Number	Engagement	Attacker Enemy Captured	Defender Enemy Captured	Attacker Times Overrun	Defender Times Overrun	Attacker Miles [illegible]	Defender Mission [illegible]	Distance Adv per Day (km)	Winner
	1956 SUEZ WAR								
16000	Abu Ageila	195	0	0	0	3	5	15	D
16010	Mitla Pass	50	0	0	0	8	5	57	A
16020	Central Sinai	100	0	0	0	7	3	25	A
16030	Rafah	1,500	0	0	0	8	4	6	A
16040	Gaza	3,300	0	0	0	9	1	30	A
16050	Sharm el-Sheikh	864	1	0	0	8	2	2	A
	1968-1973 WAR OF ATTRITION								
17200	Kerama	128				6	6	0	draw

Engagement Number	Engagement	Outcome	Attacker Casualties % per Day	Defender Casualties % per Day	Total Strength Ratio	Total Casualty Ratio	Attacker Force Mix	Defender Force Mix
	1956 SUEZ WAR							
16000	Abu Ageila	Attack Advances	1.21	5.9	4.57	0.94		
16010	Mitla Pass	Attack Advances	1.96	12.50	1.50	0.23		
16020	Central Sinai	Defender Penetrated	1.11	3.75	0.75	0.22		
16030	Rafah	Defender Penetrated	0.39	25.00	2.17	0.03		
16040	Gaza	Defender Surrounded	2.17	100.00	0.70	0.02		
16050	Sharm el-Sheikh	Defender Penetrated	0.78	33.33	1.81	0.04		
	1968-1973 WAR OF ATTRITION							
17200	Kerama	Attack Advances	0.84	3.07	0.74	0.20		

Engagement Number	Engagement	Attacker % Strength CBA	Defender % Strength CBA	Attacker % CBA of Strength Lost Daily	Defender % CBA of Strength Lost Daily	Attacker % of Close CBA	Defender % of Close CBA	Attacker Force Name	Defender Force Name
	1956 SUEZ WAR								
16000	Abu Ageila							Is Ugdah 38	Eg 6th Brigade
16010	Mitla Pass							Is 202d Para Bde (+)	Eg 2d Infantry Bde (-)(+)
16020	Central Sinai							Is 7th Armored Bde (-)	Eg 4th Armored Div (-)
16030	Rafah							Is Ugdah 77	Eg 5th Infantry Bde (+)
16040	Gaza							Is 11th Infantry Brigade	Eg 8th Palestinian Div (-)
16050	Sharm el-Sheikh							Is 9th Mech Inf Bde	Eg 21st Infantry Battalion (+)
	1968-1973 WAR OF ATTRITION								
17200	Kerama								

Appendix

II

1973 Yom Kippur War Engagement Data

1973 YOM KIPPUR WAR										
Engagement Number	Engagement	Duration (in Days)	Attacker Total Strength	Defender Total Strength	Attacker MBTs	Defender MBTs	Attacker Total Cas	Defender Total Cas	Attacker MIA	Defender MIA
17211	Syrian Assault on Mt. Hermon	1	500	55	0	0	50	44	0	20
17480	Mount Hermon II	1	500	1,000	4	0	30	10		
17490	Mount Hermon III	1	2,500	1,000	8	0	154	236		12
17370	Tel el Hara	1	12,500	14,300	285	288	401	50	9	
17400	Kfar Shams-Tel Antar	1	11,000	12,000	192	233	100	166		4
17420	Naba	1	11,500	11,000	230	192	180	100	4	
17450	Arab Counteroffensive	1	35,750	16,100	413	240	524	160	10	
17221	Suez Canal Assault, North	1	20,000	3,300	225	99	143	192	0	54
17222	Suez Canal Assault, Center	1	30,000	2,464	475	82	286	105	0	1
17223	Suez Canal Assault, South	1	30,000	3,694	570	126	286	109	0	16
17260	Third Army Buildup	1	45,160	10,980	322	135	125	181		11
17270	Second Army Buildup	1	63,910	14,000	541	192	126	352		12
17341	Kantara-Firdan I (Rev)	1	18,400	23,400	290	250	676	370	66	1
17342	Kantara-Firdan II	1	63,910	28,450	437	255	558	567	24	12
17346	Suez Canal Stalemate	4	139,120	72,000	885	750	1,421	342	61	37
17381	Second Army Offensive (Rev)	1	42,000	24,000	660	365	1,719	200	74	0
17391	Third Army Offensive (Rev)	1	42,000	12,000	480	150	2,005	130	87	0
17411	Chinese Farm I (Rev)	1	16,560	13,530	240	140	1,193	1,033	0	46
17431	Chinese Farm II (Rev)	2	26,170	36,840	341	300	785	2,866	0	128
17432	Derversoir West I	2	3,000	2,000	38	20	125	303	0	0
17441	Deversoir West II (Rev)	1	19,600	18,180	140	100	255	602	0	24
17461	Ismailia (Rev)	5	17,000	23,860	110	195	240	1,576	0	63
17471	Jebel Geneifa (Rev)	3	26,200	17,800	250	160	390	1,999	0	81
17501	Shallufa I (Rev)	1	26,200	15,800	220	130	200	546	0	22
17511	Suez (Rev)	2	10,800	8,000	120	100	339	1,122	4	500
17521	Shallufa II (Rev)	2	5,800	6,000	60	10	50	6,000	0	5,680
17531	Adabiya (Rev)	2	10,900	12,000	160	100	100	1,435	0	1,200

Engagement Number	Engagement	Attacker Enemy Captured	Defender Enemy Captured	Attacker Enemy Deserters	Defender Enemy Deserters	Attacker Mission Accomp	Defender Mission Accomp	Distance Adv per Day (km)	Winner
17211	Syrian Assault on Mt. Hermon	20	0	0	0	9	1	1	A
17480	Mount Hermon II					3	6	0	D
17490	Mount Hermon III	12				7	3	5	A
17370	Tel el Hara		9			1	9	-2	D
17400	Kfar Shams-Tel Antar	4				8	2	5	A
17420	Naba		3			2	8	0	D
17450	Arab Counteroffensive		10			2	8	0	D
17221	Suez Canal Assault, North	54	0	0	0	8	4	5	A
17222	Suez Canal Assault, Center	1	0	0	0	8	4	5	A
17223	Suez Canal Assault, South	16	0	0	0	7	4	5	A
17260	Third Army Buildup	11				8	6	3	A
17270	Second Army Buildup	12				8	6	3	A
17341	Kantara-Firdan I (Rev)	1	66	0	0	4	7	0	Defender
17342	Kantara-Firdan II	12	24	0	0	5	6	5	Defender
17346	Suez Canal Stalemate	37	61	0	0	5	5	0	Draw
17381	Second Army Offensive (Rev)	0	74	0	0	3	8	0	Defender
17391	Third Army Offensive (Rev)	0	87	0	0	5	8	0	Defender
17411	Chinese Farm I (Rev)	46	0	0	0	7	4	7	Attacker
17431	Chinese Farm II (Rev)	128	0	0	0	7	3	5	Attacker
17432	Derversoir West I	0	0	0	0	8	3	10	Attacker
17441	Deversoir West II (Rev)	24	0	0	0	8	5	5	Attacker
17461	Ismailia (Rev)	63	0	0	0	4	8	3.4	Defender
17471	Jebel Geneifa (Rev)	81	0	0	0	7	4	13	Attacker
17501	Shallufa I (Rev)	22	0	0	0	6	4	10	Attacker
17511	Suez (Rev)	500	4	0	0	3	6	5	Defender
17521	Shallufa II (Rev)	5,500		0	0	9	2	5	Attacker
17531	Adabiya (Rev)	1,200	0	0	0	8	2	22.5	Attacker

Engagement Number	Engagement	Outcome	Attacker Casualties % per Day	Defender Casualties % per Day	Total Strength Ratio	Total Casualty Ratio	Attacker Force Mix	Defender Force Mix
17211	Syrian Assault on Mt. Hermon	Defender Surrounded	10.00	80.00	9.09	1.14		
17480	Mount Hermon II	Failed Attack	6.00	1.00	0.50	3.00		
17490	Mount Hermon III	Defender Penetrated	6.16	23.60	2.50	0.65		
17370	Tel el Hara	Failed Attack	3.21	0.35	0.87	8.02		
17400	Kfar Shams-Tel Antar	Attack Advances	0.91	1.38	0.92	0.60		
17420	Naba	Failed Attack	1.57	0.91	1.05	1.80		
17450	Arab Counteroffensive	Failed Attack	1.47	0.99	2.22	3.27		
17221	Suez Canal Assault, North	Defender Penetrated	0.71	5.82	6.06	0.74		
17222	Suez Canal Assault, Center	Defender Penetrated	0.95	4.26	12.18	2.72		
17223	Suez Canal Assault, South	Defender Penetrated	0.95	2.95	8.12	2.62		
17260	Third Army Buildup	Attack Advances	0.28	1.65	4.11	0.69		
17270	Second Army Buildup	Attack Advances	0.20	2.51	4.57	0.36		
17341	Kantara-Firdan I (Rev)	Failed Attack	3.67	1.58	0.79	1.83		
17342	Kantara-Firdan II	Failed Attack	0.87	1.99	2.25	0.98		
17346	Suez Canal Stalemate	Limited Attack	0.26	0.12	1.93	4.15		
17381	Second Army Offensive (Rev)	Failed Attack	4.09	0.83	1.75	8.60		
17391	Third Army Offensive (Rev)	Failed Attack	4.77	1.08	3.50	15.42		
17411	Chinese Farm I (Rev)	Attack Advances	7.20	7.63	1.22	1.15		
17431	Chinese Farm II (Rev)	Defender Penetrated	1.50	3.89	0.71	0.27		
17432	Derversoir West I	Defender Penetrated	2.08	7.58	1.50	0.41		
17441	Deversoir West II (Rev)	Defender Penetrated	1.30	3.31	1.08	0.42		
17461	Ismailia (Rev)	Failed Attack	0.28	1.32	0.71	0.15		
17471	Jebel Geneifa (Rev)	Defender Penetrated	0.50	3.74	1.47	0.20		
17501	Shallufa I (Rev)	Defender Penetrated	0.76	3.46	1.66	0.37		
17511	Suez (Rev)	Failed Attack	1.57	7.01	1.35	0.30		
17521	Shallufa II (Rev)	Defender Surrounded	0.43	50.00	0.97	0.01		
17531	Adabiya (Rev)	Defender Penetrated	0.46	5.98	0.91	0.07		

Engagement Number	Engagement	Attacker % Strength CIA	Defender % Strength CIA	Attacker % CIA of Strength (per day)	Defender % CIA of Strength (per day)	Attacker % of Cas CIA	Defender % of Cas CIA	Attacker Force Name	Defender Force Name
17211	Syrian Assault on Mt. Hermon							Syr Bn, 82nd Parachute Rgt	Is 17th Bn, Golani Bde (elms)
17480	Mount Hermon II							Is Golani Bde	Syr 82nd Para Rgt (+)
17490	Mount Hermon III							Is Golani Bde (+)	Syr 82nd Para Rgt (+)
17370	Tel el Hara							Ir 3d Armd Div	Is 240th Armd Div
17400	Kfar Shams-Tel Antar							Is 240th Armd Div (-)	Ir 3d Armd Div
17420	Naba							Jor 40th Armd Bde (+)	Is 240th Armd Div
17450	Arab Counteroffensive							Syr 9th Inf Div (-) (+)	Is 146th Armd Div
17221	Suez Canal Assault, North							Eg 18th ID (+) and Port Faud TF	Is Northern Sector, Sinai Division
17222	Suez Canal Assault, Center							Eg Second Army (-)	Is Central Sector, Sinai Division
17223	Suez Canal Assault, South							Eg Third Army	Is Southern Sector, Sinai Division
17260	Third Army Buildup							Eg Third Army	Is Mendler's Division
17270	Second Army Buildup							Eg Second Army	Is Adan's Division (-) (+)
17341	Kantara-Firdan I (Rev)							Is Adan Div (-) (+)	Eg 2nd Inf Div and 18th Inf Div (-)
17342	Kantara-Firdan II							Eg Second Army (-)	Is Southern Command (-)
17346	Suez Canal Stalemate							Eg Second and Third Armies	Is Southern Command
17381	Second Army Offensive (Rev)							Eg Second Army (Elms)	Is Sasson's Force and Sharon's Divisions (+)
17391	Third Army Offensive (Rev)							Eg Third Army (elms0	Is Magen's Division
17411	Chinese Farm I (Rev)							Is Sharon's Division (+)	Eg 16th Infantry Division (-) (+)
17431	Chinese Farm II (Rev)							Is Adan's Division (+)	Eg 16th Infantry Division (+)
17432	Derversoir West I							Is Sharon's Division (-)	Eg Elms Second Army
17441	Deversoir West II (Rev)							Is Adan's Div (-) (+)	Eg Elms Second Army
17461	Ismailia (Rev)							Is Sharon's Div (-) (+)	Eg Elms Second Army
17471	Jebel Geneifa (Rev)							Is Adan's and Magen's Divisions	Eg Elms Third Army
17501	Shallufa I (Rev)							Is Adan's and Magen's Divisions	Eg Elms Third Army
17511	Suez (Rev)							Is Adan's Division (-)	Eg Elms Third Army
17521	Shallufa II (Rev)							Is Tamari Force	Eg Elms Third Army
17531	Adabiya (Rev)							Is Magen's Division	Eg Elms Third Army

Appendix

III

Falklands War Engagement Data

FALKLANDS WAR										
Engagement Number	Engagement	Duration (In Days)	Attacker Total Strength	Defender Total Strength	Attacker MBTs	Defender MBTs	Attacker Total Cas	Defender Total Cas	Attacker MIA	Defender MIA
19201	Darwin-Goose Green	1	548	1,324	0	0	52	223	0	173
19202	Top Malo House	1	20	17	0	0	3	16	0	10
19203	Mount Harriet	1	550	500	0	0	14	70	0	70
19204	Two Sisters	1	550	500	0	0	12	121	0	120
19205	Mount Longdon	1	550	500	0	0	70	138	0	88
19206	Mount Tumbledown	1	550	500	0	0	52	114	0	34
19207	Wireless Ridge	1	550	500	0	0	3	88	0	88

Engagement Number	Engagement	Attacker Enemy Captured	Defender Enemy Captured	Attacker Enemy Deserters	Defender Enemy Deserters	Attacker Mission Accomp	Defender Mission Accomp	Distance Adv per Day (km)	Winner
19201	Darwin-Goose Green	173	0	0	0	9	1	8.5	A
19202	Top Malo House	10	0	0	0	9	1	0.2	A
19203	Mount Harriet	70	0	0	0	8	2	8	A
19204	Two Sisters	120	0	0	0	8	2	8	A
19205	Mount Longdon	1	0	0	0	9	2	8	A
19206	Mount Tumbledown	34	0	0	0				
19207	Wireless Ridge	88	0	0	0				

Engagement Number	Engagement	Outcome	Attacker Casualties % per Day	Defender Casualties % per Day	Total Strength Ratio	Total Casualty Ratio	Attacker Force Mix	Defender Force Mix
19201	Darwin-Goose Green	Defender Penetrated	9.49	16.84	0.41	0.23		
19202	Top Malo House	Defender Penetrated	15.00	94.12	1.18	0.19		
19203	Mount Harriet	Defender Penetrated	2.55	14.00	1.10	0.20		
19204	Two Sisters	Defender Penetrated	2.18	24.20	1.10	0.10		
19205	Mount Longdon	Defender Penetrated	12.73	27.60	1.10	0.51		
19206	Mount Tumbledown	Defender Penetrated	9.45	22.80	1.10	0.46		
19207	Wireless Ridge	Defender Penetrated	0.55	17.60	1.10	0.03		

Engagement Number	Engagement	Attacker % Strength CIA	Defender % Strength CIA	Attacker % CIA of Strength (per day)	Defender % CIA of Strength (per day)	Attacker % of Cas CIA	Defender % of Cas CIA	Attacker Force Name	Defender Force Name
19201	Darwin-Goose Green							UK 2nd Bn, Para Rgt	Arg 12th Inf Rgt (+)
19202	Top Malo House							UK RM Mountain & Arctic Warfare Cadre	Arg 602nd Commando Company
19203	Mount Harriet							UK RM 42 Commando	Arg 4th Inf Rgt
19204	Two Sisters							UK RM 45 Commando	Arg 4th Inf Rgt
19205	Mount Longdon							UK 3rd Bn, the Parachute Regiment	Arg 7th Infantry Regiment
19206	Mount Tumbledown							UK 2nd Bn, Scots Guards	Arg 5th Marine Bn
19207	Wireless Ridge							UK 2nd Bn, the Parachute Regiment	Arg Bn, 7th Inf Rgt, elms 1st Parachute Rgt

Appendix
IV

Persian Gulf War Engagement Data

PERSIAN GULF WAR ENGAGEMENTS										
Engagement Number	Engagement	Duration (In Days)	Attacker Total Strength	Defender Total Strength	Attacker MBTs	Defender MBTs	Attacker Total Cas	Defender Total Cas	Attacker MIA	Defender MIA
19101	Ops 4, 5, and 6	2	4000	19500			9	14	9	0
19102	Al Wafrah--Kuwaiti Orchard	2	4000	20119			200	0	0	0
19103	Khafji	4	12000	4000			460	68	400	0
19104	Between the Wire	3	20000	7000			6	590	0	388
19107	1st MarDiv Breach	1	19515	21000	126		10	4300	0	4000
19105	Objective ROCHAMBEAU	1	11500	10500				430	0	430
19106	Umm Gudair Oil Field (2d MarDiv Breach)	1	20298	17500	260		14	3000	0	3000
19108	Al Burqan Airfield	1	12500	19500		126	2000	17	2000	0
	PL NEW JERSEY to PL SMASH I cannot find									
19113	Al Busayyah (Objective PURPLE)	2	17269	7000	357		20	570	0	570
19114	Big Fight -- IRON v. Tawalkana	2	5200	1250	86		8	863	0	263
19115	PL BULLET--READY FIRST's Combat	2	5200	2500			18	200	0	200
19116	73 Easting - DRAGON's Roar	2	5700	1000			6	100	0	100
19117	RFCT Attack to Objective MINDEN	2	5200	2000	100			500	0	500
19118	Big Night-1 ID (M) at Objective NORFOLK	2	16607	6000	348		41	300	0	300
19119	BP 101-197 IN BDE at Tallil Airfield	2	5000	7500		2	2	1335	0	1269
19120	Objective ORANGE (Jalibah Airfield)	1	14000	5000			10	200	0	200
19121	Medina Ridge	1	17300	5300			31	839	0	839
19122	3 ACR at Ar Rumaylah Airfield	1	5200	3000				165	0	165
19123	AO BRAGG	2	15000	6000			5	245	0	245

Engagement Number	Engagement	Attacker Enemy Captured	Defender Enemy Captured	Attacker Enemy Deserters	Defender Enemy Deserters	Attacker Mission Accomp	Defender Mission Accomp	Distance Adv per Day (km)	Winner
19101	Ops 4, 5, and 6	0	9	0	0	4	8	3	D
19102	Al Wafrah--Kuwaiti Orchard	0	0	0	0	3	8	0.96	D
19103	Khafji	0	400	0	0	4	7	7.16	D
19104	Between the Wire	388	0	0	0	8	3	1.94	A
19107	1st MarDiv Breach	4000	0	0	0	8	2	35	A
19105	Objective ROCHAMBEAU	430	0	0	0	9	1	60	A
19106	Umm Gudair Oil Field (2d MarDiv Breach)	3000	0	0	0	8	3	30	A
19108	Al Burqan Airfield	0	2000	0	0	2	8	-8	D
	PL NEW JERSEY to PL SMASH I cannot find								
19113	Al Busayyah (Objective PURPLE)	570	0	0	0	8	2	90.57	A
19114	Big Fight = IRON v. Tawalkana	263	0	0	0	8	3	20	A
19115	PL BULLET--READY FIRST's Combat	200	0	0	0	7	6	14	A
19116	73 Easting - DRAGON's Roar	100	0	0	0	8	3	22	A
19117	RFCT Attack to Objective MINDEN	500	0	0	0	8	3	40	A
19118	Big Night-1 ID (M) at Objective NORFOLK	300	0	0	0	7	3	20	A
19119	BP 101=197 IN BDE at Tallil Airfield	1269	0	0	0	8	2	30	A
19120	Objective ORANGE (Jalibah Airfield)	200	0	0	0	8	2	25	A
19121	Medina Ridge	839	0	0	0	9	2	30	A
19122	3 ACR at Ar Rumaylah Airfield	165	0	0	0	8	2	45	A
19123	AO BRAGG	245	0	0	0	8	1	30	A

Engagement Number	Engagement	Outcome	Attacker Casualties % per Day	Defender Casualties % per Day	Total Strength Ratio	Total Casualty Ratio	Attacker Force Mix	Defender Force Mix
19101	Ops 4, 5, and 6	Failed Attack	0.11	0.04	0.21	0.64		
19102	Al Wafrah--Kuwaiti Orchard	Failed Attack	2.50	0.00	0.20			
19103	Khafji	Failed Attack	0.96	0.43	3.00	6.76		
19104	Between the Wire	Defender Penetrated	0.01	2.81	2.86	0.01		
19107	1st MarDiv Breach	Defender Penetrated	0.05	20.48	0.93	0.00		
19105	Objective ROCHAMBEAU	Defender Penetrated		4.10	1.10			
19106	Umm Gudair Oil Field (2d MarDiv Breach)	Defender Penetrated	0.07	17.14	1.16	0.00		
19108	Al Burqan Airfield	Failed Attack	16.00	0.09	0.64	117.65		
	PL NEW JERSEY to PL SMASH I cannot find							
19113	Al Busayyah (Objective PURPLE)	Defender Surrounded	0.06	4.07	2.47	0.04		
19114	Big Fight -- IRON v. Tawalkana	Defender Penetrated	0.08	34.52	4.16	0.01		
19115	PL BULLET--READY FIRST's Combat	Attack Advances	0.17	4.00	2.08	0.09		
19116	73 Easting - DRAGON's Roar	Defender Penetrated	0.05	5.00	5.70	0.06		
19117	RFCT Attack to Objective MINDEN	Defender Penetrated		12.50	2.60			
19118	Big Night-1 ID (M) at Objective NORFOLK	Defender Penetrated	0.12	2.50	2.77	0.14		
19119	BP 101--197 IN BDE at Tallil Airfield	Defender Penetrated	0.02	8.90	0.67	0.00		
19120	Objective ORANGE (Jalibah Airfield)	Defender Penetrated	0.07	4.00	2.80	0.05		
19121	Medina Ridge	Defender Penetrated	0.18	15.83	3.26	0.04		
19122	3 ACR at Ar Rumaylah Airfield			5.50	1.73			
19123	AO BRAGG	Defender Surrounded	0.02	2.04	2.50	0.02		

Engagement Number	Engagement	Attacker % Strength CIA	Defender % Strength CIA	Attacker % CIA of Strength (per day)	Defender % CIA of Strength (per day)	Attacker % of Cas CIA	Defender % of Cas CIA	Attacker Force Name	Defender Force Name
19101	Ops 4, 5, and 6							IZ 5th ID (M) (-) (+)	US 1 RCN Bn, 1 and 3 LAI Bns (-) (+)
19102	Al Waffah–Kuwaiti Orchard							IZ 5th ID (M) (-) (+)	US 2 LAI Bn (-) (+)
19103	Khafji							IZ 5th ID (Mech) (+)	Elms RSLF (+)
19104	Between the Wire							US 2d Mar Div (elms): 3/23 Mar (+)	IZ 29 ID (elms)
19107	1st MarDiv Breach							US 1st Mar Div	IZ 29 ID, 5 MECH DIV
19105	Objective ROCHAMBEAU							FR 6th LAD (+)	IZ Bde, 45th ID
19106	Umm Gudair Oil Field (2d MarDiv Breach)							US 2d MarDiv	IZ 7, 14 Divs
19108	Al Burqan Airfield							IZ elms 5 MECH DIV, 3 AD	US 1st MarDiv
	PL NEW JERSEY to PL SMASH I cannot find								
19113	Al Busayyah (Objective PURPLE)							US 1 AD	IZ 26 ID (elms)
19114	Big Fight -- IRON v. Tawalkana							US 2 BDE, 3 AD	IZ 9 AR BDE, Tawalkana DIV
19115	PL BULLET–READY FIRST's Combat							US 1 BDE, 3 AD	IZ 9 AR BDE, Tawalkana Div
19116	73 Easting - DRAGON's Roar							US 3d Bde, 1st AD	Ir 29th Mech Bde (elms), Tawalkana Div
19117	RFCT Attack to Objective MINDEN							US 1 BDE, 3 AD	IZ 9 AR BDE, Tawalkana DIV (elms)
19118	Big Night-1 ID (M) at Objective NORFOLK							US 1st Infantry Division (M)	IZ Tawakalna Mech Div (elms), 12th AD (elms)
19119	BP 101–197 IN BDE at Talil Airfield							US 197 IN BDE, 24 ID	IZ 3 CDO RGT, elm Baghdad Inf Div (RGFC)
19120	Objective ORANGE (Jalibah Airfield)							US 1st, 2d Bdes, 27th ID (M)	IZ 49th ID (elms)
19121	Medina Ridge							US 1st AD	Ir Medina Div (+)
19122	3 ACR at Ar Rumaylah Airfield							US 3 ACR	elms IZ Nebuchadnezzer ID (RGFC)
19123	AO BRAGG							US 82d Abn Div(+)	IZ ak-FAW, Nebuchadnezzar Divs (elms)

Appendix

V

Post-World War II Campaign Data

POST-WORLD WAR II CAMPAIGNS										
Engagement Number	Engagement	Duration (in Days)	Attacker Total Strength	Defender Total Strength	Attacker MBTs	Defender MBTs	Attacker Total Cas	Defender Total Cas	Attacker MIA	Defender MIA
6000	MUSKETEER	3	21,500	2,000	16	4	155	1,735	0	185
6010	KADESH: Israeli Attack in the Sinai	8	44,450	34,500	200	104	1,092	11,000	4	6,000
6020	The Sinai, 1967	5	79,000	90,000	445	930	1,764	12,980	11	4,980
6030	The West Bank, 1967	3	65,700	52,000	303	288	2,995	2,931	0	2,000
6040	Golan Heights, 1967	2	0	0	290	700	756	1,870	4	570
6050	BADHR: Egyptian Attack on Israel	9	200,000	92,500	2,090	1,100	5,474	3,489	327	209
6060	BADHR: Syrian Attack on Israel	17	147,500	104,000	1,489	675	10,915	3,333	520	108
6070	STRONGHEART, Israeli Counteroffensive	8	165,000	200,000	904	1,679	3,974	19,675	4	7,822
7000	Land Operations on East Falklands	45	8,500	0			1,054	15,265	0	13,245
8000	Desert Storm, 100-Hour War	5	400,000	0	3,360	2,087	1,045	64,000	5	0

Engagement Number	Engagement	Attacker Enemy Captured	Defender Enemy Captured	Attacker Enemy Deserters	Defender Enemy Deserters	Attacker Mission Accomp	Defender Mission Accomp	Distance Adv per Day (km)	Winner
6000	MUSKETEER	185	0	0	0	8	3		Attacker
6010	KADESH: Israeli Attack in the Sinai	864	0	0	0	7	5		Attacker
6020	The Sinai, 1967	5,500	0	0	0	9	2		Attacker
6030	The West Bank, 1967	530	0	0	0	7	5		Attacker
6040	Golan Heights, 1967	500	0	0	0	8	5		Attacker
6050	BADHR: Egyptian Attack on Israel	209	327	0	0	6	5		Attacker
6060	BADHR: Syrian Attack on Israel	65	370	0	0	8	2		Defender
6070	STRONGHEART, Israeli Counteroffensive	7,822	4	0	0	7	3		Attacker
7000	Land Operations on East Falklands	13,245	0	0	0	8	1		Attacker
8000	Desert Storm, 100-Hour War	63,000	5	0	0	8	2		Attacker

Engagement Number	Engagement	Outcome	Attacker Casualties % per Day	Defender Casualties % per Day	Total Strength Ratio	Total Casualty Ratio	Attacker Force Mix	Defender Force Mix
6000	MUSKETEER	Defender Surrounded	0.23	19.28	7.33	0.09		
6010	KADESH: Israeli Attack in the Sinai	Defender Penetrated	0.30	4.58	1.50	0.10		
6020	The Sinai, 1967	Defender Penetrated	0.44	2.60	0.80	0.14		
6030	The West Bank, 1967	Attack Advance	1.48	1.78	1.23	1.02		
6040	Golan Heights, 1967	Defender Penetrated	0.70	1.61	0.93	0.40		
6050	BADHR: Egyptian Attack on Israel	Attack Advance	0.30	2.18	10.00	1.57		
6060	BADHR: Syrian Attack on Israel	Failed Attack	0.46	0.29	2.06	3.27		
6070	STRONGHEART, Israeli Counteroffensive	Defender Surrounded	0.30	1.23	0.83	0.20		
7000	Land Operations on East Falklands	Defender Surrounded	0.28	2.22	0.56	0.07		
8000	Desert Storm, 100-Hour War	Defender Surrounded	0.05	5.77	1.80	0.02		

Engagement Number	Engagement	Attacker % Strength CIA	Defender % Strength CIA	Attacker % CIA of Strength (per day)	Defender % CIA of Strength (per day)	Attacker % of Cas CIA	Defender % of Cas CIA	Attacker Force Name	Defender Force Name
6000	MUSKETEER							Anglo-French Forces	Port Said Regional Defense Forces
6010	KADESH: Israeli Attack in the Sinai							Is Southern Command	Eg Eastern Military Zone
6020	The Sinai, 1967							IS Southern Command	EG Sinai Field Army
6030	The West Bank, 1967							IS Central Command (+)	Jor West Front
6040	Golan Heights, 1967							IS Northern Command (+)	SY Golan Field Army
6050	BADHR: Egyptian Attack on Israel							Eg Second and Third Armies	Is Southern Command
6060	BADHR: Syrian Attack on Israel							Sy Army	Is Northern Command
6070	STRONGHEART, Israeli Counteroffensive							Is Southern Command	Eg Second and Third Armies
7000	Land Operations on East Falklands							UK 3d Royal Marine Commando	Arg Falklands Garrison
8000	Desert Storm, 100-Hour War							US Third Army	Ir Army